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BUILDINGS FOR INDUSTRY

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An Architectural Record Book

Published by F. W. Dodge Corporation

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FOREWORD

More industrial buildings, by more architects, and in more places—this triad quickly summarizes what has been happening in industrial architecture. Since the last compilation of material from the pages of ARCHITECTURAL RECORD was published in 1951 under the title *Industrial Buildings,* the world of industry has not only grown in size and importance; it has also expanded into new fields and to more and new locations. The two developments are related, of course; as business increases, industry develops new products and new markets, and so extends functionally and geographically as well as statistically. Inevitably, more architects have become involved in producing the necessary buildings.

It follows that this book offers a great diversity of types of buildings under the general heading of industrial. Adding to this diversity is the fact that architecture is at last penetrating into some businesses—like lumber yards or steel fabricating plants—which, though long on the scene, are virtually new clients for architects.

Warehouses are another old type of business that is currently giving architects new problems. We have had warehouses, of course, since the beginning of trade, but it is only in recent years that scientific methods have been developed to cut handling costs and make full use of modern materials-handling equipment. Truck-docking and terminal facilities have also emerged from back-alley construction and, with the aid of engineering consultation on trucking methods, have become true contemporary architecture, functionally planned and scientifically designed. All of these developments have produced a sweepingly new set of requirements for warehouses and have revolutionized their design. Unlike its predecessor, this book has a separate section for such buildings.

Not all the emphasis in this book is on the novel. In particular, some ARCHITECTURAL RECORD articles which were collected in the 1951 *Industrial Buildings* have such continuing validity that they have been reproduced, with little if any change, in the present volume. Most of these are in the first, or "Design Principles" section, as might be expected.

Among the manufacturing buildings proper are represented plants of all sizes and degrees of complexity, housing operations that range from light manufacturing to the heaviest industry, from the bottling of soft drinks to the building of helicopters. An increasingly important category is that of the industrial laboratory which manufactures the products of its own research.

Included also are plants for the utilities and service industries, for the repair and maintenance of vehicles, the printing of newspapers, the generation of power, even for an enterprise devoted exclusively to mail-order campaigns.

The staff of ARCHITECTURAL RECORD has based its selection of the articles on the significance of the designs, both as original ideas and final achievements; and architects, engineers, and the executives of industry may well study them with profit.

Emerson Goble

Managing Editor

ARCHITECTURAL RECORD

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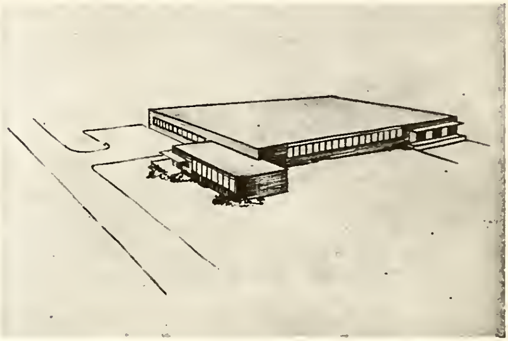
NEWER TRENDS IN INDUSTRIAL BUILDINGS

By Frank L. Whitney

Chief Engineer, Walter Kidde Constructors, Inc.

IN THE YEARS SINCE THE WAR there has been an amazing activity in the construction of smaller industrial buildings. In this rapid expansion there has been a definite trend toward decentralization. These two factors, each with many ramifications, have not only spread the work of the design professions, but also produced many changes in programming and design, also in construction techniques.

There is a third factor, which is perhaps more important than either of those first two in the changing concepts and uses of industrial buildings. That is the development of a highly organized system of truck transportation. It makes no particular difference that reliable trucking has been built up to accommodate changes in our distribution system: the solid fact is that over-the-road transportation has made possible a wide dispersion of American industry and a far-flung complex of factories, warehouses, sales and service buildings and truck terminals. Transportation factors have always determined the location and design of industrial buildings, and as transportation changes, so do the buildings. It is the purpose of this article to examine quickly some of the more important aspects of the changing industrial scene, and to trace some of the effects in the design of industrial buildings.



Small buildings, in small cities — many warehouses

The dispersal of industry is a central if obvious fact. Though this has been a stated objective of government, as a safety measure in case of bombing attack, the other reasons for moving to the country are quite compelling. They are of course familiar, and need only brief mention here. Congestion is both expensive and unpleasant, two very cogent arguments for dispersal. Today parking space for employees' cars is likely to be more important than mass transportation for workers. City taxes drive industry outward. So do labor considerations. So do land costs. Given good roads, automobiles for workers, trucks for materials and finished products, dispersal is almost automatic.

More important perhaps than these common inducements is the distribution system. Markets today are not confined to city concentrations; markets are everywhere. As the once-undeveloped areas — the South, for example, or the West — become increasingly important market places, industry moves out to serve them. And there follows an ever-growing complex of small factories, distribution centers, warehousing and service facilities, garages, truck terminals. If in all of this development the old-time wholesaler has all but disappeared, the complicated distribution system that replaced him still needs buildings — more buildings rather than less, and buildings of more different types and designs.

CHANGES IN THE FACTORY

The planners of factory building have gained important freedoms in this dispersal movement, just as the industrialist has. It is axiomatic that the factory building is designed around the production line. With a large plot available, the designer is free to accommodate the assembly line in any desired alignment, disposing his areas as he sees fit. He can place storage areas, power plant, employee facilities, truck docks as the process demands. And he can arrange for expansion or for future changes without restrictions because of limited land area.

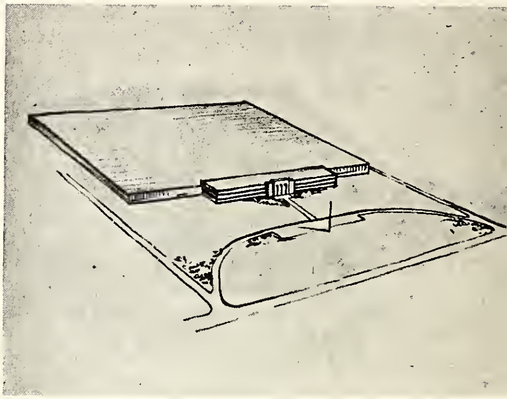
These are the more obvious freedoms; there are some new ones, however, which may not be so apparent. Take the matter of storage. In each type of plant there are individual problems of storing raw materials on the one hand and finished goods on the other hand. These are problems that need constant re-examination. It may be found, for example, that coordination of delivery arrangements may cut down or virtually eliminate the areas commonly reserved for storage. It may be much more efficient to take finished products off the line and directly into carriers and out of the plant. There are in fact manufacturing plants that would have to shut down if the outgoing transportation should be tied up for even a few days; they have simply eliminated storage of finished goods. Such an arrangement might be entirely feasible for one factory, but completely impossible in another. Or, the distribution system and the particular location may introduce delivery factors that might reverse the design criteria for materials and product handling. It is not news, of course, that materials handling problems are major design considerations; the point here is that modern distribution systems, completely outside the plant, introduce new complications within the plant, and that these may vary widely in different locations.

In architectural design the new freedoms are increasingly in evidence. The architectural concept of the industrial plant has in the past decade been radically revised. Industry readily accepted the principles of contemporary architectural design in its early stages, and with few exceptions these principles were put into full use in the suburban development. This because there was no required architectural tie-in with existing designs as had been the case in the expansion of most existing urban plants. Also, and more importantly, the economies of contemporary design were probably its greatest impetus. The industrialist found that he could have an attractive-looking plant in the contemporary style at no additional cost and in many cases, under an intelligent direction, actually at reduced cost. There were, of course, the few exceptions in industry where traditional pattern was desired, in which the industrialist was willing to accept the added cost. It is interesting to note that in most of these cases actual inefficiency of operations developed and the ability to design the logically expanding plant was considerably limited.

Another strong design influence is the federal tax structure. With few exceptions it seems to be the manufacturer's desire to develop the lowest capital expenditure, and while this is not exactly news, there may be a curious reversal due to tax factors. Without tax considerations the designer would try to work out a building which would give his client the best economy over the years, balancing first cost against annual operating costs; he might spend a bit more initially to save maintenance expense. But with high annual corporate taxes on profits there is less reason to invest more heavily at first, since the maintenance expense becomes an allowable item of cost.

This consideration could reverse again if the plant were for defense production, its cost written off in five years as permitted by the government as an inducement to undertake construction.

One word of warning here. This principle of balancing tax factors does not imply any general carelessness about manufacturing costs. The point is that manufacturing costs are not the same as building maintenance costs, and the latter are presumably small by comparison. Low manufacturing costs might indeed be the principal reason for construction of the plant. It is nevertheless true that, once the building is properly planned for low-cost manufacturing, costs of operating and maintaining the building itself are not overpowering considerations.



"The architectural concept of the

Perhaps a more positive way of saying it is that the cost of the building is weighed primarily in relation to manufacturing costs, and this relationship is quite variable. In an earlier day a factory building was supposed to last fifty years, and was dignified with a sort of institutional quality. Too frequently the old pile did last that long, and the industry suffered accordingly. Today we think of a factory building as merely a housing facility for a certain layout of machines and the necessary personnel facilities. And the industry is prepared to enlarge it, change it, sell it, or abandon it entirely, whenever it begins to hamstring the operations. We expect a certain fluidity in manufacturing operations, and we design for it as we can.

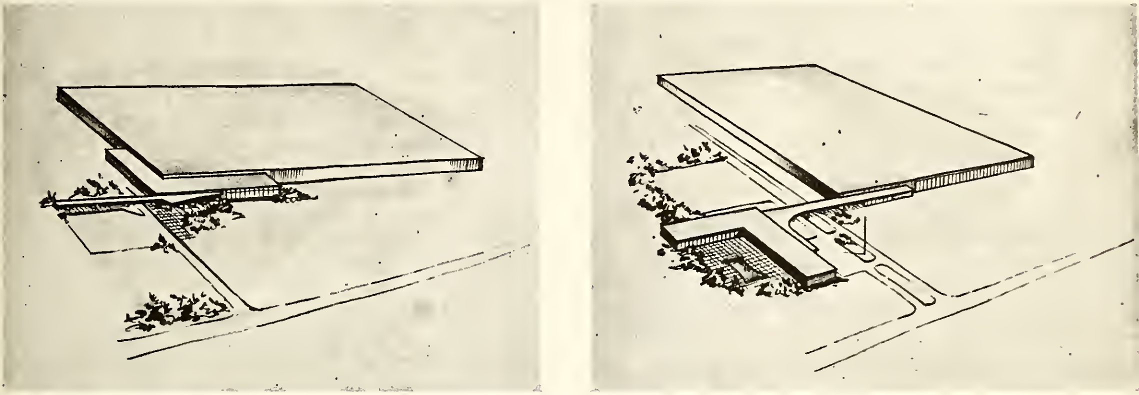
In planning a building, then, the designer leads his client away from institutional monumentality, in favor of flexibility, expandability, perhaps even demountability.

THE FACTORY WALL

Here, then, the logical building approach is a wall which can be economically expanded or revised as the production facility is expanded or revised. Here we find masonry at a disadvantage, basically because of its inflexibility. However, in many cases the manufacturer, it seems, is desirous of masonry from the standpoint of appearance. This because brick is a building material he is used to, together with the fact that most of the panels on the market today were originally developed as a cheap substitute building material. The effort to utilize them architecturally has been a relatively recent experiment and is taking hold with difficulty. Although the use of panels has been taking hold with some difficulty, it is easy to predict its acceptance; one reason being the increasing shortage of masons, the other being the development of newer and better panels which will demonstrate lower maintenance cost and furnish the desired flexibility and resultant economy.

A new interest in the building market is the plastic panel. In most cases this is a corrugated panel of fiber glass mat impregnated with a resin. At the present time it is at a disadvantage since it is not fireproof. However, it is only a matter of time before this feature will be corrected. It has been in various laboratories already. It should have a great future. In some cases it will be the answer to problems which we have been unable to solve with the known building materials. For example, in a chlorine atmosphere these plastic panels are about the only thing we have that will stand up over a period of years without considerable maintenance. The use of plastic panels will open new vistas for the architectural designer and will have a tendency to change or modify our thinking in industrial lighting.

There are, of course, areas in the industrial building where at present the owner is justified in his desire for masonry. In food plants the smooth interior finish of the glazed tile wall is about the most economical construction where sanitation is not only desired but required.

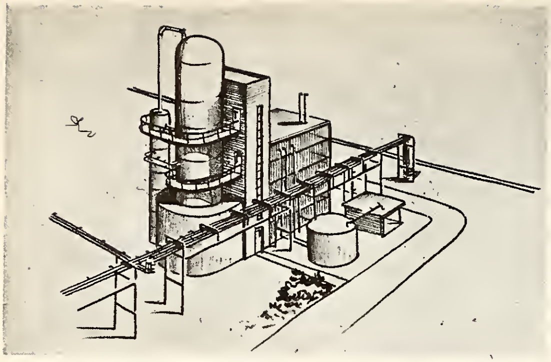


industrial plant has in the past decade been radically revised.”

At any rate, it would seem to be healthful to think of the industrial plant more as a shell over a mechanical process than as the ancestral home of a corporation, and try to design for fast-changing times.

One must go further along this line and inquire as to whether the factory building is a separate entity or part of the machine process. As the trend toward most "automation" continues, automatic controls are continually replacing human machine operators, until eventually it might develop that the buildings need scarcely be designed for human comforts but for machine covers. We should not be too long in recognizing that the instrument does not need the same housing facility. The instrument can also get to various levels with relative ease and without stairs. Consequently the electronic devices and relays may bring back verticality, reversing the horizontal trend.

There may come a time when the factory designer will face a difficult decision — whether to house the machine or the man. Although he might recognize that



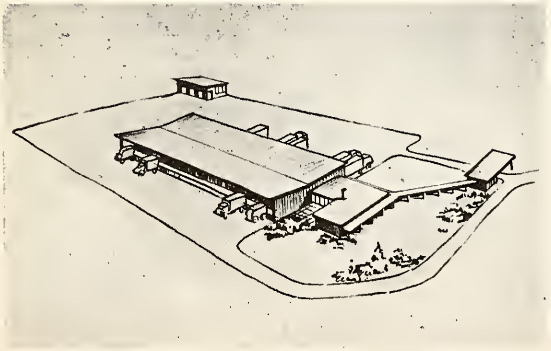
". . . a shell over a mechanical process . . ."

the operator is no longer at the machine, but is rather a technical man moving about merely servicing automatic machinery, he will still face resistance, for the maintenance man will expect the same kind of air conditioned building to work in that the machine operator always had. Perhaps there would be weather conditions occasionally which would make his maintenance work difficult, but the coincidence of bad weather and breakdown would surely be infrequent, so infrequent as to make it economically unsound to design a conventional building cover merely for machine maintenance. Lest you think that this begins to sound like merely a mechanized nightmare, the author had these problems in a large refining plant which did leave many of the machines in the open.

WAREHOUSES AND TRUCK TERMINALS

In the design of a warehousing facility or a truck terminal the architectural approach is almost completely the economical building, for the developed cost of the structure itself is a large part of the total operating cost of a warehouse. In a manufacturing facility building cost might run only a third of the equipment cost and in some process facilities even less than that. Consequently, the importance of structure varies with use. In the highly competitive warehousing field the ingenuity of the architect is taxed greatly because of the highly competitive nature of business and because of the importance that the cost of the structure will play in the operation.

Truck terminal, a new building type



One of the most typical solutions of a warehousing problem is the masonry bearing wall with the light open-web long-span joist roof. The masonry bearing wall is particularly suited to warehousing; inasmuch as it is a working wall it will demonstrate certain economies. Its one big disadvantage is its inflexibility for future expansion. This, of course, is not of major importance in the warehousing and terminal field inasmuch as new facilities can be separate units without much difficulty of operation.

Further studies of the warehousing structure have been centered around the column spacing. It is the natural desire of almost every warehouse operator to have as much clear and unlimited space as possible. However, again the economics of structure enter this picture. When one attempts to develop a span somewhere beyond 40 feet in length, economy dictates that he go to a truss type member and although the steel in pounds per square foot of building is less on a truss building, the cost per pound is relatively high, due to the greater fabrication cost. Consequently, a great deal of study has been devoted to economic spans for this type of building.

There are several factors to be considered: economic sprinkler head spacing and spans which would accommodate the maximum palletized storage. One bay spacing which has been developed and seems to be admirably suited for most warehouse layouts approximates the 24 by 33 foot bay. This seems to approach the maximum in sprinkler head coverage. It facilitates the use of relatively economically wide flange sections which can either be cantilevered over the columns or more simply connected. Although the pound per square foot of steel is somewhat higher than in some of the other schemes, the fabricated and erected cost due to the simplicity of design brings it within the economic range.

One more general remark on warehouses and truck terminals: they really should not be lumped together so blithely, and they appear in several different uses and types. In a sense a warehouse is the opposite of a truck terminal: the warehouse stores the goods; the truck terminal is designed to speed a handling process with an absolute minimum of storing.

Warehouses might be as widely different as the products they store — furniture vs. frozen foods, fish vs. vitamin pills. And naturally their design problems are widely different.

Truck terminals are tending to be much alike, if they are intended, that is, for commercial or contract truck lines. But the bulk of the truck fleets are owned by private corporations — Coca Cola trucks, for example — so terminals for them vary again as widely as the operation involved.

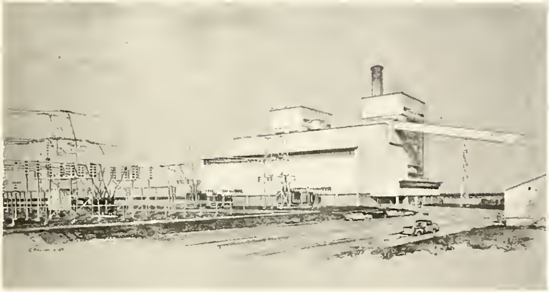
Sufficient to say here that they are getting to be big business, in every highway crossroads. And they are worthy of real study by the designer, being types of buildings where functional aspects assume great importance in a highly competitive field.

FACTORS AFFECTING INDUSTRIAL BUILDING DESIGN

In april of 1954 the Society of Industrial Realtors, a division of the National Association of Real Estate Boards, surveyed the national market for industrial buildings and sites. Their findings revealed certain strong owner preferences which show how economic and social pressures can affect industrial building design, and demonstrated a steady demand for good industrial locations coupled with a growing scarcity of prime industrial land. The members reported on activity then current in comparison with that of the previous six months.

The market for industrial sites showed an increased dollar volume of sales and price increases ranging from 10 to 20 per cent for improved land (5 to 25 per cent for unimproved) wherever change was noted, with very few reports of lower volume or costs. As to type of buildings, a continuing heavy demand for one-story buildings existed, with prices and volume of sales stable. On the other hand, multi-story plants were beginning to be a drug on the market, with more offered for sale, fewer buyers, and prices weakening.

Left, Kansas City Power and Light Co., Hawthorne Station: height and volume determined by mechanical space requirements within



Ebasco Services, Inc., Designers

Barancik, Conte & Assoc., Architects; Hedrich-Blessing Photo

Above, Interstate Steel Warehouse and Office, Evanston, Ill.: rigid steel framing for a one-floor plant makes floor beams carry the load

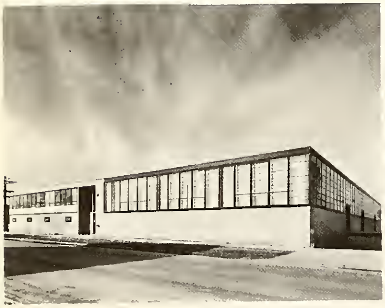
These were not direct architectural-engineering design determinants: no generality can cover each specific owner's case; but there did appear to be a clear implication that the low, spread-out plant, which requires a generous site found in suburban or rural areas and not within city limits, had proved economically sound. Another significant trend was discovered: more small plants (less than 50,000 sq ft) were being bought than large structures (over 50,000 sq ft) although only a slight change in prices for either was noted; and warehousing was in about equal demand with manufacturing space. These trends seemed to continue after the survey was made.

Against this background of industrial development the Los Angeles Chamber of Commerce held an Institute on Industrial Plant Design early in March. Previously — late in 1953 — the National Industrial Zoning Committee (whose membership includes development, planning, transportation, engineering, realty and state governmental agencies in the industrial field) issued a preliminary report on the characteristics of recently built industrial plants in a search for bases for adequate, workable industrial zoning codes. While the Committee sampling did not seem large enough for accurate evaluation, its tentative findings closely paralleled recommendations independently made at the Los Angeles Institute. On these principal sources, plus comment from informed individuals, the following discussion is based.

W. T. Herzog, Archt.; Bob Natkin Photo

Bert Mills Corp., St. Charles, Ill.; manufacturers of coffee vending machines; plant carefully designed against fire hazard. Paint spray room, above, is sprinklered, has explosion-type windows; is surrounded by firewall

Small plant for Dresser Manufacturing Co. is one story, like Interstate Warehouse on preceding page



Hedrich-Blessing Photo

Sound Programming Is Essential

The program prepared before an industrial plant — or laboratory or headquarters building — is designed almost always determines the success or failure of the undertaking. What is a good program like? What is the programming process? In essence it is merely a statement of needs; but the needs are so complex that several years may be required to formulate them clearly to relate their numerous categories and sub-categories properly and thus ensure an economical, efficiently functioning, attractive plant. For one thing, architects and engineers belong in the picture early; as early as possible. There are numerous advantages in starting an intimate owner-architect-engineer collaboration as soon as the decision to build becomes definite. The paramount reason is that, since these members of the design professions are trained above all to coordinate the many diverse elements of building programs and structures, which range from petty personal prejudices to the characteristics and behavior of materials and equipment, they can save an owner much precious time — which is to say, money. There are all too many instances of misdirected energy, of time wasted by owners on structural matters or space organization, which are the designers' functions. The designers' independent, experienced viewpoint is indispensable at the time that preliminary discussions are undertaken and when tentative decisions are made.

The owner has important, definite functions, too: he specifies what the plant is to produce, the volume of production for which space and facilities are to be provided, the manufacturing or processing procedure, and the probable need for future expansion — all parts of the analysis of the fundamental problem. He provides his architects and engineers with data, and very likely sketches, showing the desired floor pattern, area, facility and process requirements; he determines the need for driveways, rail spurs, parking, employe amenities and environmental control. He provides machine layouts and initiates the study of efficient handling and routing of materials through his proposed process. At this stage the capable architect or engineer says nothing; he listens. Next, equipment suppliers are consulted, individual spaces and clearances begin to be studied, and the designers' work gets under way.

Preliminary studies — whose importance is tremendous because, as the first crystallizations of ideas, they influence all later work — now begin to come from the architect. Ideally, the required spaces are related not only to each other but also to a site's topography, which means that at this time a certain site is being considered (see below). In these early studies appear general layout and land use; flow of operations; approximate dimensions and in general terms the type of expansion; rail, highway or water transportation facilities, parking, etc. These can determine the desirable site size; and in the building itself, column spacing, headroom, location of toilets and other such facilities. The next step is to determine upon a type of construction, the appropriate kinds of materials, extent and nature of mechanical and electrical systems. After this — and everything up to this point, in the ideal case, has been produced by the collaborating owner-architect-engineer team — the final preliminaries should come from the architect, be thoroughly discussed and changed if necessary; and at last the project is ready for working drawings and specifications to start.

The Site Influences the Program

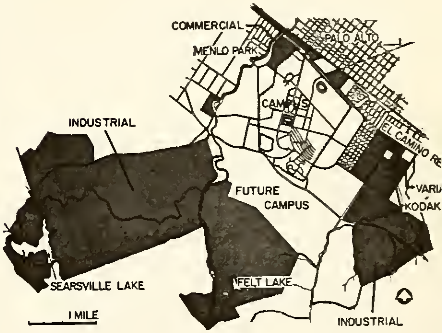
To a larger degree than is apparent the site has a direct influence on the ultimate efficiency of the plant through the effects of site factors on plant design and construction. The architect knows what these are; when full use is made of his abilities he is consulted in site selection. Some of the general determinants of a site's value are: geographic location, proximity of competitors (for one industry it may be good to be among competitors, for another, harmful); sources and availability of raw materials; relation to suppliers of components, accessories, etc.; local climate (prevailing winds, sun heat load, humidity — does the process require dust-free atmosphere? high or low operating temperature?); local power and fuel sources; industrial and fire protection water (domestic water is rarely a problem); sewage and waste disposal possibilities; tax rates; labor force (how much parking will be needed?); transport facilities. After these general factors are considered come the specifics: land contours (existing or easily modified contours may actually simplify solution of traffic, loading dock, or multi-level processing problems); soil strength (affects column spacing, internal plant layout, foundations, height of building); hidden rock, springs or potential flood conditions. All these bear investigation by a reliable engineer, who can also advise on width of land and gradient required for a rail spur; ground water level; frostline; subsidence tendencies.

In comparing an urban with a rural or suburban location, it should be borne in mind that the value of a "central" location is sometimes exaggerated; in regard to the distance labor will have to travel, for instance, time is a more accurate measure of satisfaction than the actual distance in miles. Employe parking for *all* employes is a must; one cannot get by today with less. Regarding smaller communities, the impact of a plant on local road problems, sewers, schools and the labor market must be considered. The attractive plant creates good will; the ugly one breeds ill feeling. Suburban labor has proved to be more stable than urban.

Automation Affects Design

Automation has been defined as "*automatic performance by machine instead of by hand of many production operations simultaneously or in sequence, to reduce human operation and get a better product at lower cost in less time.*" In a study undertaken by David G. Osborn for the Department of Geography of the University of Chicago, automation was found to affect program requirements (and hence plant design) in definite ways. In a number of instances automation tended to free the process from dependence on a large labor supply. More important was the availability of some semi-skilled labor, with high school education plus 2 years' technical training. Designing the production equipment, its controls and the plant to house them, however, was found to be a more complex problem, and buildings for automatic processes were found to be uniformly smaller in area by from 12 to 94 per cent, with the number of employes reduced by from 13 to 92 per cent. This lessens the requirements for employe facilities (toilets, cafeteria, parking, etc.) substantially. Automation also reduces employe density, or in other words increases the space per employe, by an average of 28 per cent, while increasing output, on the average, some 380 per cent. In terms of building area required, the amount per unit of product was reduced by an average of 59 per cent — automation, then, may cut floor area requirements in half. The lower employe density and smaller building size also change the nature of the impact of a plant on a community's transit system, housing, schools, services, parks, etc., and reduce the required site area. In some instances automatic plants have been built far away from an established "mother" plant to avoid antagonizing an existing labor force.

STANFORD UNIVERSITY INDUSTRIAL DEVELOPMENT, *Palo Alto, Calif. The last large tract of undeveloped land on the peninsula south of San Francisco is 5500 acres owned by Stanford University. This is a little more than half the original holdings, and under the terms of its grant cannot be sold. Five years ago Stanford started leasing land for residential, commercial and light industrial use, engaging Skidmore, Owings & Merrill as master planners for over-all development. Within this framework a $15 million shopping center (Welton Becket & Assoc., Archts.-Engrs.) has been built in the commercial area, a small residential subdivision has been opened, and with less publicity light industry started to come in. Stanford favors no special types of industries, judges each individually, applies stiff restrictions. Plant operation must be clean, quiet, odorless; site must be landscaped; offstreet parking is required; no stacks, water tanks or advertising display are permitted; minimum set-back is 50 ft; Palo Alto zoning ordinance applies; Stanford must approve design. Lot size is not predetermined. A rural, parklike character is being effectively maintained. The master plan is a governing policy rather than a design implemented by precise drawings*



Environmental Control

Modification of internal environment to improve working conditions and production is not a new story, although the arguments pro and con a totally controlled atmosphere continue to crop up. In some cases, atmospheric control is rendered essential by the nature of the process. In the Puerto Rican Consolidated Cigar Plant (see page 148), for example, the atmospheric requirements were extremely stringent. Here raw materials and finished products alike are seriously affected by temperature and humidity; and the machinery is largely automatic, the workers unskilled, emotional and from rural surroundings, the climate violent and public relations important. In addition to the need for air conditioning, these factors resulted in careful design of lighting for the windowless plant, pleasing use of strong color to relieve monotony, and acoustical correction in certain areas, while at the same time they made integration with the site, heavy thermal insulation and provision of recreational and cafeteria facilities imperative. In these and the other examples the full range of requirements is evident.

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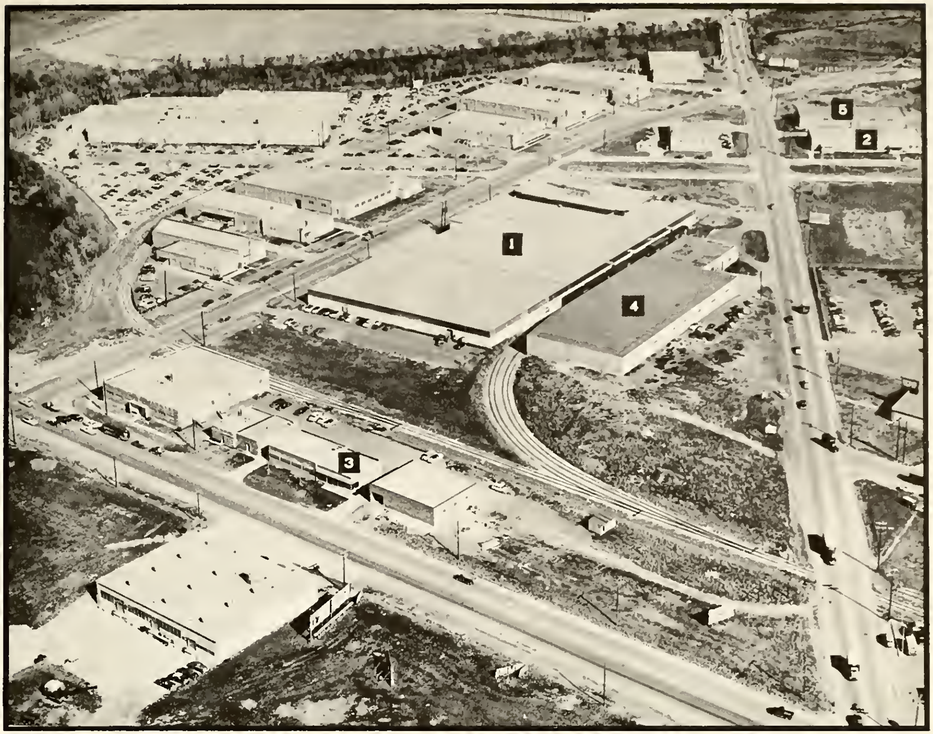
TRINITY INDUSTRIAL PARK, DALLAS, TEX.; *Jacob E. Anderson, Archt. Twenty-five years ago Dallas gained a Levee District, created by building 30-ft levees and a new channel for the Trinity River. On this land Trinity Industrial District was developed as a planned, restricted area served by 3 main-line railroads; it is now a center for motor freight service. In 1950, Trammell Crow, Dallas builder and investor, began development of Trinity Industrial Park on part of the District land. The Park, too, is restricted; devoted to light industries and distribution facilities in what is to become a park-like environment, its leases require landscaping, architect-designed buildings, wide setbacks, homogeneous materials and similarity of scale. Street parking is excluded as far as possible, with parking lots, rail spurs and truck docking for each building. All present buildings have salmon brick walls except the Goodrich building, which has buff tile. Walls are load-bearing brick and lightweight block, roofs rest on steel joists; all buildings are heated, air conditioned, with asphalt or rubber tile floors and acoustical ceilings. Orientation required overhangs to shade southern and western glass (western windows are eliminated where possible); roofs are heavily insulated. Streets are wide, usually depressed (so are tracks), with building floor slabs cast on grade at truck or car dock level — a substantial saving. Photos: bottom air view, entire District; top air view, Trinity Park. Buildings: 1, B. F. Goodrich Warehouse; 2, General Electric X-ray Division and Harris-Seybold Building; 3, Black & Decker; 4, Clampitt Paper Co.; 5, General Cable Corp.*



Air views, Squire Haskins; other photos, Ulric Meisel

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MATERIALS HANDLING AND INDUSTRIAL ARCHITECTURE

By Irving E. Ingraham
of Giffels & Vallet, Inc., L. Rossetti
Engineers and Architects

Lens-Art

CONTEMPORARY INDUSTRIAL ARCHITECTURE typifies the integration of architectural design with all phases of engineering. Modern industry has come to realize that buildings are as much a part of the productive and operative processes as are power distribution and plant layout. Professional services are now based on the thesis that there can be no clear division between the process and plant, and that architecture must be developed in close harmony with the plant layout and its equipment and services.

A natural result of this development has been that industrial projects — once considered primarily in the engineer's domain — have become equally the concern of the architect; and commercial, public and institutional works — once primarily the architect's province — have become the concern of the engineer. It has, of course, always been true that the structural engineer worked closely with the architect. But recent emphasis has been to have the equipment, plant layout, electrical, and mechanical engineers work closely together with the architect to produce an integrated, efficient plant or commercial establishment which is both esthetic and functional.

This modern integration of architecture and engineering is appropriately called Industrial Architecture, even though it is applied regularly to commercial and institutional projects as well as industrial. The name conveys the necessity for all modern structures to house materials handling devices and to provide for the proper flow of materials, vehicles and personnel.

For example, it was once considered sufficient for a public building, such as a post office, to have a monumental and pleasing appearance, which is to say its design was primarily an architectural function. Now it must also include the integration of all of the engineering fields, and be laid out to provide efficient materials handling. In skillful hands, such a building can be treated as a unified pattern and functional items which initially appear to be troublesome can be made to offer welcome relief and provide opportunities for accent and variation within a suitable over-all design.

The design of this post office parallels that of an industrial plant, and would commence with building layout to suit the site and provide for efficient receipt, flow and shipping of mail and materials. Analyses of conveyors, docks, lift trucks, palletizing, automatic cancelling, stacking and sorting, employee facilities, pedestrian flow, mail-by-auto facilities, and public services all enter into the layout and must be combined functionally within a suitable over-all design.

The industrial plant, conversely, was once considered solely a productive process which, unfortunately, had to have a functional housing of some sort. It was only recently that the layout and design of a factory became the province of any professional group, when production management turned to engineers for assistance in developing plant layout and design.

Industrial facilities produced under this emphasis rapidly developed along the lines required by modern automation and mass production; that is, they were laid out to meet straight line flow and to provide for efficient materials handling.

As the modern architect-engineering firms began to serve both of these fields there evolved a conscious plan to achieve the integration of architecture and engineering necessary for an efficient, economical plant which was by nature, functional, simple and pleasing. It may well be that this coordination of the two professions has been ingrained in the personnel of these firms as a heritage of their association, rather than having come about as a conscious plan. The necessity to provide personnel flexibility to meet the rapidly changing workload in this cyclical business has made many of these individual engineers do some work as architects and many of the architects work on plant layout and various phases of engineering. This flexibility of training and knowledge on the part of these professional personnel has been a logical part of the process for the integration of architecture and engineering.

Industrial projects now usually commence with plant layout, at which stage the general outlines of the plant and departments and choices of equipment are established. Then architectural studies proceed apace with more detailed engineering, as the two are interdependent. The fundamental emphasis is on plant layout, which is the backbone of all good industrial facilities. In turn, plant layout is fundamentally an arrangement to meet the proper flow of materials.

The handling of materials represents most of the physical activity in a plant. Raw materials, materials in process and the finished product are the basis of its existence. From the receiving dock materials are unloaded, moved, stored, removed and stored, and moved into manufacturing. During the manufacturing process they move, wait in process and move through numerous operations and surge storages, through inspection and packaging to final storage. From there they go to the shipping dock and final handling.

This basic material flow in all industrial plants, whether processing or warehousing, is a major part of the activity. It absorbs many man hours, and may cover high costs hidden in inventory, space utilization and curtailed output. Materials handling is a top consideration of all management and so of the architect-engineer.

Conveyors are often considered to be the basic materials handling device and, in the sense that materials handling encompasses machinery, they are. There are literally hundreds of different types of conveyors and other materials handling devices which are often the heart of a plant activity.

A single conveyor is often the basic item around which a plant is built. An example of this which quickly comes to mind is the assembly plant, where various components are added, one to the other, as the basic frame travels on a continuous conveyor. These components may be sub-assembled adjacent to the main conveyor, or received as individual parts or complete sub-assemblies from another plant.

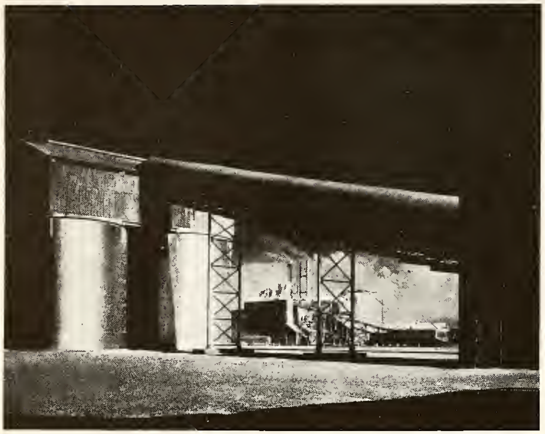
The continuous mold conveyor in the modern foundry and such other plants as those manufacturing foam rubber mattresses is an example of this type of conveyor. Here molds are filled, prepared and assembled either on or adjacent to the conveyor. On the conveyor they are poured, cooled, otherwise processed and emptied of their product.

Probably more fundamental than the conventional mechanical conveyor to modern materials handling is the lowly and unsung fork lift truck, which has facilitated the modern concept of the unit load. This concept is that materials in any phase of production — raw storage, in process, or finished form — should be handled in as large a load of individual units as is possible. This is achieved by palletizing, tote boxing or otherwise packaging the material into a several thousand pound load that can be readily lifted, transported and stacked by lift truck. Of course these same unit loads are also conveyed on roller, belt and other conveyors or crane; but the transferring, storing and conveying medium normally is the lift truck. Utilization of trucks determines aisle patterns, storage area and ceiling heights (the latter to permit stacking), which enter into the configuration of the structure.

A logical extension of the unit load concept has been the complete elimination of units. In many industries, materials such as limestone, wheat and petroleum are conveyed through much or all of the production processes in bulk. Here the utilization of pneumatic conveying, belt conveying, hopper cars and cranes has not only eliminated many costs associated with packaging, but they have also had their effect upon architecture.

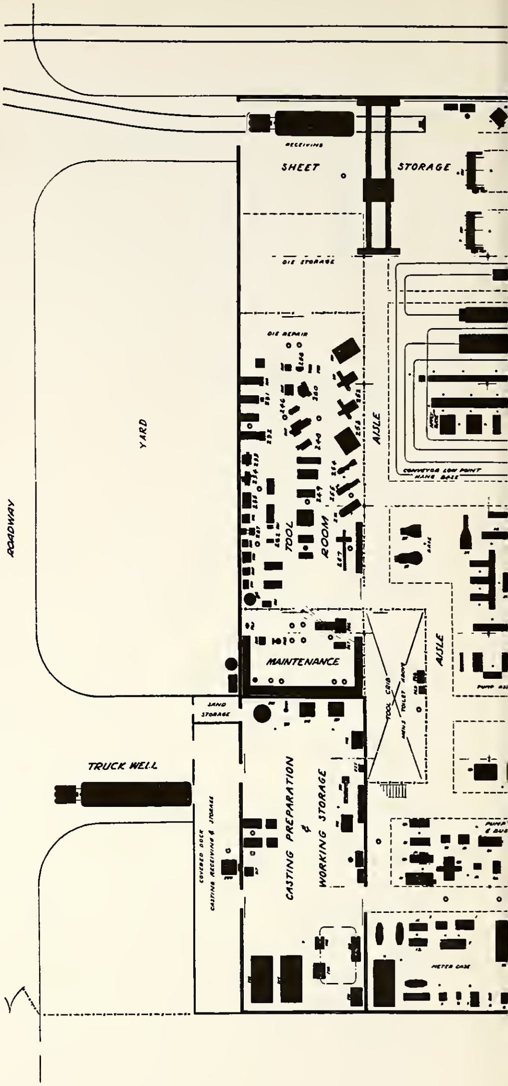
The architectural trend to facilitate this modern materials handling has been an almost universal and natural adoption of the single story building. This one level floor plant facilitates efficient arrangement of parts and assembly lines, and also provides for ease of materials handling by conveyors, cranes, monorails and lift trucks. The phrase "one level" in its broad sense, includes mezzanine, basement and penthouse areas which are frequently employed to conserve cubage and to keep auxiliary services adjacent to the areas they serve. The single story building normally, and for all intents and purposes, is equal in cost to the multi-story building for an equivalent floor area. The latter is usually not considered to be worth the sacrifice in materials handling required in vertical transportation between floors.

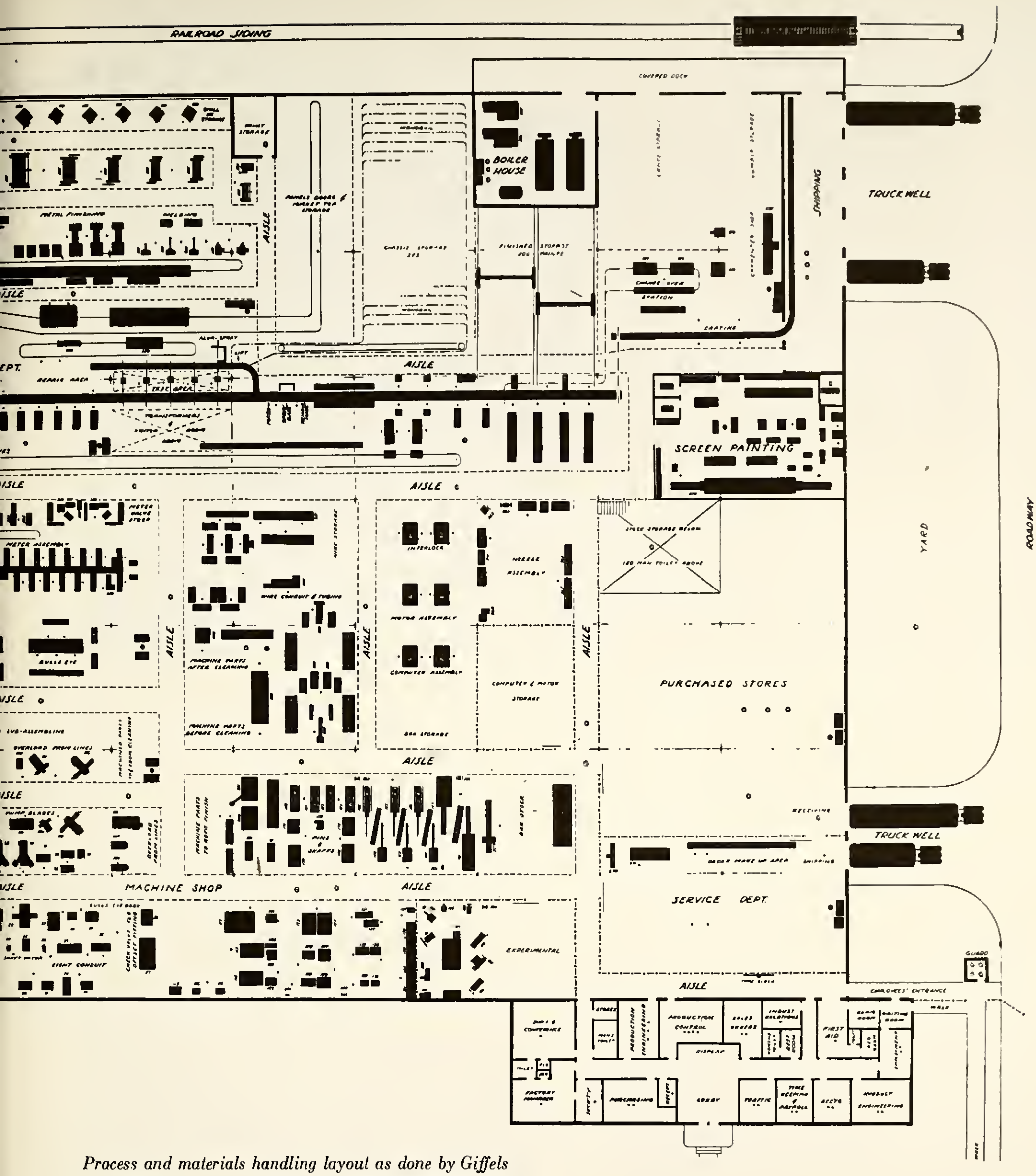
The multi-story building is still required in many production processes, especially in the chemical and allied fields where a vertical flow is a production necessity. The multi-story structure requires a minimum of ground area and is utilized for this reason oftentimes on expensive urban properties.



Lens-Art

Lens-Art





Process and materials handling layout as done by Giffels & Vallet, Inc., L. Rosselti, for a plant manufacturing industrial machinery. After a great deal of preliminary study, the layout takes form on a huge table, with templates of all machines, conveyors and so on. While the detailed study of such a layout as this would be meaningless, certain facts are seen. For example, there are four truck docks, three of which are positioned to bring in materials and supplies at proper points, one for shipping only (one is used for both receiving and shipping). Notice also how much of the area is devoted to parts or materials in storage in various manufacturing locations. It can readily be seen that materials handling is just about all-important in making a scheme like this, and of course in the final efficiency of the factory

AN ENLIGHTENED LOOK AT A FACTORY

One of the Nation's Most Progressive Industrialists Defines the Ideal Factory Building in Terms of his own Concept of Management

GENERAL ROBERT JOHNSON, fabulous head of the Johnson & Johnson enterprises, has said that the vast majority of all American factories are obsolete and ought to be razed. Such a damning generalization is based partly on his own high standards of factory buildings and partly on his concepts of industrial management. The two go hand in hand in the Johnson organization, for the definition of what constitutes a good factory building springs from a peculiarly enlightened concept of modern management.

One major tenet, for example, is that a factory should be small. If the enterprise is large, like the Johnson enterprise is, production should be broken up among small units. If this idea seems to run counter to the familiar concept of efficiency and economy of mass production in the mammoth plant, it is consistent with two major principles by which the Johnson organization keeps its balance sheets in healthy condition.

One of these is that the worker must be considered to be a human being as well as a production unit; the other is that plant managers are also human beings. The task of the big boss is primarily one of arranging matters so that manager and worker can meet on common ground, so that the manager can run his own show without being swamped under too much direction from the main office, and can spend his time with his workers. That meeting ground is most likely to be, says the General, a small factory, ideal in its standards of working conditions, beautiful in appearance, conducive to pride in both manager and workers, conducive also to close contacts between management and worker.

General Johnson sums it up by saying that American business should reverse its present trend toward concentrated central management, and begin to "delete, delegate, decentralize and, if necessary, delouse the central staff." It is practically religion in the J & J

Nothing is more inspiring, or cheaper to acquire and maintain, says the Johnson management, than grass and trees. A landscaped setting for a factory conditions the worker, even before he has parked his car, to the Johnson philosophy of good housekeeping and self respect

family that a plant manager be an individual, responsible as such for his own unit in the Johnson world, be it manufacturing sterile bandages or Diesel engines.

There is no essential difference in standards for a plant making bandages and one making engines, according to this philosophy. There are six basic essentials to industrial management, says Johnson: (1) good housekeeping; (2) simplicity and beauty of plant and facilities; (3) human engineering; (4) decentralization; (5) emphasis on youth; (6) cost consciousness.

It is not so hard now to understand the General's statement that the large percentage of American factories are obsolete. It is not so difficult, either, to understand why J & J industrial plants differ widely from each other, each newer one reaching ever higher in the scale of architectural and engineering achievement.

The human engineering which is so important in all of this is not achieved by ignoring the more technical sciences. Indeed in building a new plant the J & J organization strains to the utmost the ingenuity of the man who is to manage the new plant, the architect and engineer, the process engineer, the machine manufacturer, and all other consultants who might make a contribution to a factory scientifically engineering for human engineering, not forgetting the color consultant and the landscape architect. The modus operandi for locating and designing a new plant is pretty well codified; here it is as given by F. N. Manley, director of construction for J & J factories.

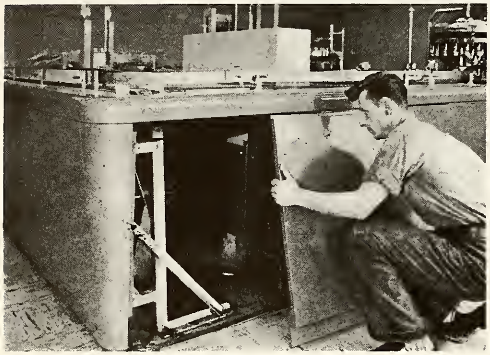
Selecting the Site

First of all in the selection of a site is a general understanding of the kind of plant to be built. It will be a one-story building. The determination is rather positive on this point. It will be out away from congested city areas, away from any "industrial slums." Johnson does not want to operate in industrial slum conditions. It is largely a matter of environment, as said before, and the effort is to get away from prearranged environments, lest management and worker alike be affected.

So the site will tend to be in a country area, with the expectation that workers will drive their own cars to it. It will be a large site, for these same reasons plus some others reasons of cold economics.

The rule as to size is to figure out present square foot requirements, also those seen for 10 and 15 years in the future, then multiply by 6 to get site requirements. This would be much too liberal for a metropolitan site, but not for a country location.

Factors in this size-demand are several: First, it takes



Photos at left: Wm. R. Frutchey. Above Ezra Stoller

The Johnson passion for order and for design extends to the production machinery. Every possible working part is to be enclosed in something colorful and easy to clean, so that the girls on the assembly feel the fitness of the nurses costumes they are given

three and a half acres for a railroad siding with a right-angle turn. Next, it requires one acre to park 100 cars; if a multiple shift is contemplated, more parking space will be required.

Perhaps the most important reason for a large site is flexibility for expansion. The design must be such that the plant can be extended on any of its four sides, so that extensions can be made without the need for reshuffling existing layouts.

And finally, in the Johnson thinking there is nothing prettier or less expensive to maintain than grass. And nothing quite so conducive to contented working as a pleasant, landscaped, parklike setting. Before the worker has even parked his car he has been conditioned to order and beauty.

Then come considerations of market, utilities, transport, labor, and perhaps publicity value if the site can be near a main highway or a main rail line. Then starts the search, and it is likely to be a long one.

Designing the Plant

The concept will rely heavily on the architect to express in the building the note of orderliness and the appeal of esthetics. The plant need not be designed for the most expensive materials (though marble was used for a whole façade in one plant), but it must have that quality which is recognizable in capable architectural design. This compositional expressiveness is not taken lightly by the J & J organization.

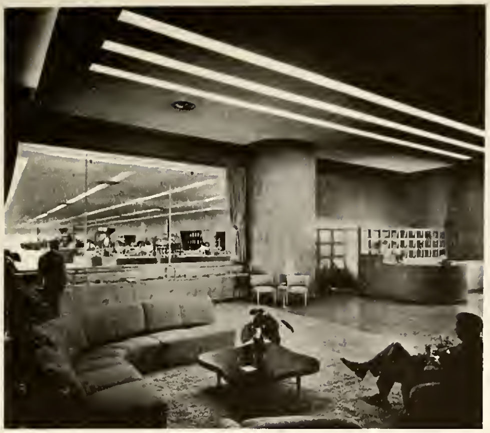
The building will be as open as possible in plan and arrangement of processes. Partitioning is to be used only as a last resort. Here again environmental reasons enter into it—the aim is always to clean up a dirty process rather than to isolate it. So minimum partitioning does more than preserve flexibility—it becomes another urge to orderliness and good planning for good housekeeping.

This housekeeping fixation is pressed heavily on the designers. All materials in the building must constantly remind everyone in the plant that he himself has obligations to the standards bestowed on his workshop and the dignity given his job. Materials and surfaces must not only be easy for him to maintain; they must also be a demand on his sense of responsibility. As a matter of fact there is cold-cash reasoning here: maintenance is left to individual workers wherever possible. Cleaning up is not a separate payroll item. It does not mean that everything is sterile, gleaming white; on the contrary, pleasant, comfortable color schemes are expected to add to the general atmosphere.

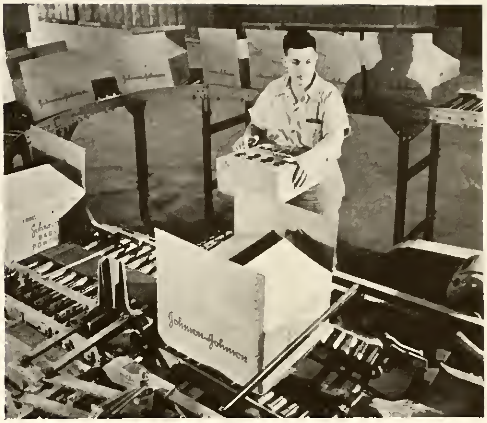
The same strain is put upon designers of process equipment. The general rule is to enclose everything possible in clean, colorful coverings, hiding all possible working parts and oily bearings. Usually an industrial designer is retained to modify machine designs and work out color schemes, all to the end that girls can operate them safely and simply, without soiling the nurses' uniforms that management provides for them.

Column spacing will be fairly wide, for flexibility. The column pattern will be square if possible, so that it does not dictate the direction of machine layouts. There is no standard column spacing, but 35 ft. is fairly common.

The plant definitely will have windows. The first reason is the J & J belief that some daylight is desirable in working light. Psychology provides the second reason. The theory here is that it is normal for the worker to have daylight in daylight hours, this going a little deeper than the usual statement that workers



Wm. R. Frutchey Photo



Above: In the new plants there is no employees' entrance. The workers are welcomed through the reception lobby with as much consideration as, say, the visitors who come for inspection trips. Right: If there is an automatic machine, the plant will have it

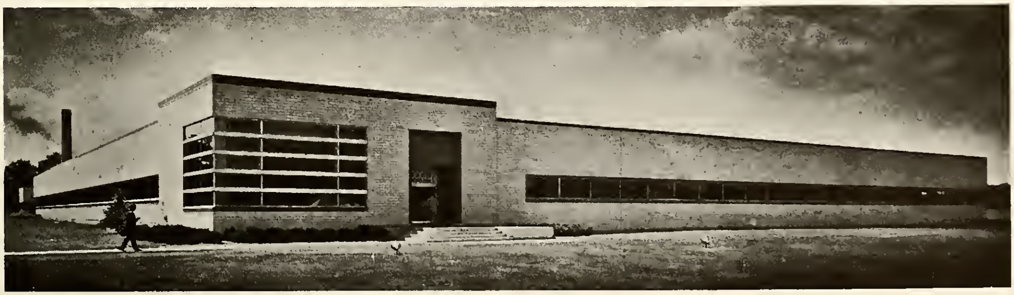
need to feel in touch with the weather and not shut away from nature. Windows are not relied on for ventilation; they are usually fixed double glass, solar glass if required.

Air conditioning will be extensively used. Acoustic materials will frequently be used. Lighting will be the best that can be engineered. The greatest attention will be given to the floors—they "have never found one good enough," and they have tried them all. They like a concrete floor, provided it is laid smooth enough; if a glasslike surface can be had, the floor will be very comfortable. The floor will be as light in color as possible.

Employees will be given many "extras." They will not be luxurious or expensive, and all will contribute to the welfare that is practically a religious fervor here. There will be good rest rooms, and a lounge for card games or table tennis. There will probably be a speaker system for music, for employees' functions, and for training or corrective purposes. There is a story, for example of this last, that broken glass plagued one plant manager to the point of distraction. Finally a personnel expert got the employees to stage some playlets over the plant speaker system. The skits ridiculed the worker who was unable to handle glass. The breakage promptly dropped by 85 per cent.

And finally, there probably will *not* be a separate employee's entrance. Employees are presumed to be "as good as" the management personnel or the visitors who are so frequently brought to J & J plants. Workers come in through the front door, through the handsome lobby, past all the display material. What better way to add dignity to the worker's job? Perhaps this idea, more than any other, portrays the Johnson theories of plant management and factory design.

The J & J factory will always be a one-story building, in the center of a large plant, expansible in any of the four directions

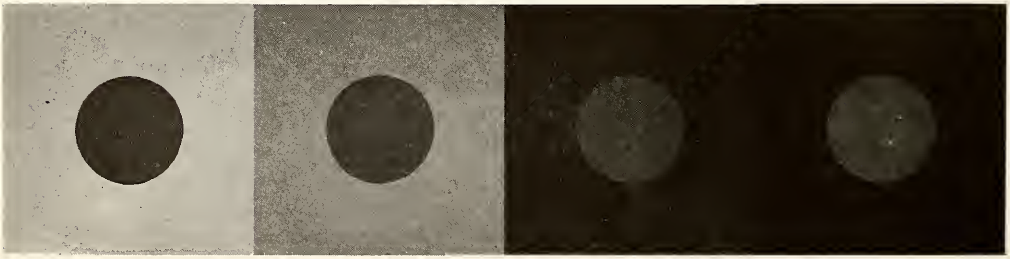


FUNCTIONAL COLOR

In a recent article, a member of an able firm of architects who have designed many outstanding industrial buildings in the United States referred to the use of planned color in manufacturing plants as being under study by his organization, to be further employed if results of the study were encouraging. A professional colorist views this statement as a surgeon would the assertion that anesthesia is still on trial.

Sufficient case histories, and surveys by government and by private associations of manufacturers now exist to prove not only that properly engineered functional color does accomplish desirable results, but also that it is an essential element not to be disregarded in the planning of any building where tasks of concentrated seeing are required. Functional color has had, and has before it, a hard fight to win due recognition in the architect's mind, but it will ultimately prevail as did the practice of acoustic correction. One remembers the day when architects thought they could take acoustics or let them alone, but today acoustic materials are specified without quibble wherever they are needed or desirable.

Yet eyesight is obviously more necessary than hearing to human well-being. Eyes are responsible for from 75 to 90 per cent of the usefulness of human actions, and 87 per cent of all sense impressions are received through them. Conditions that help eyesight help people. Conditions that hinder good sight may affect the whole human organism by causing headaches, dizziness, nausea and indigestion. Even the heart-rate remains more normal under good conditions of seeing. In the writer's experience, a factory reported that girls engaged in sorting and inspecting small, glistening metal parts upon a moving belt were frequently nauseated and obliged to take time out to rest. Polaroid glasses to cancel specular reflections, and stopping the belt at intervals of time, furnished the cure and increased production. Since this seeing problem was due more to the effects of light than of color, the point may be made here that light and color are Siamese twins. Neither can exist without the other. Good seeing requires that



IN INDUSTRIAL BUILDINGS

By Julian Ellsworth Garnsey, Colorist

both be skillfully designed. In this paper it will be assumed that lighting problems, too complicated to be treated here, have been correctly solved.

What procedure, then, shall an architect follow in his endeavor to specify color which promotes good seeing? To begin with, he should take note of some peculiarities of vision which are fundamental to the solving of his problems. These are inherent in the construction of the human eye and in its system of transmitting visual impressions to the brain. In spite of its marvelous accuracy and adaptability as an instrument of seeing, the eye enjoys tolerances in its operations which would never be allowed in a man-made tool of precision. Principal among these which should be taken into account by the architect are:

1. Simultaneous Contrast

The eye sees no color within its field of vision as a fixed quantity, but only as modified by the simultaneous perception of adjacent colors. The color seen is modified as to hue, value and intensity. As to hue: each color seen will tend to cast a tinge of its *complementary* color upon the adjacent colors. As to value: dark colors will make adjacent colors appear lighter and vice versa. As to intensity: strong colors will weaken adjacent colors.

This phenomenon of vision is perhaps the one most frequently overlooked in architectural practice. Materials which are to be placed contiguously in a building are often chosen separately without regard to their mutual interaction, sometimes with surprising final results. In industrial plants the phenomenon may be advantageously used to emphasize work in hand, to separate machines from their background and to enliven a general color scheme for psychological effect upon the workers. For instance, a tan background of low reflectance will strengthen the general bluish hue of steel castings and accentuate their forms for quicker handling while copper or brass objects, generally toward orange in hue, will be easiest seen against gray blue-green. Rows of medium green machines will reveal their contours, if that be desired, against light pinkish gray. On the walls, pale gray tints may be "forced" into apparent color, without losing their necessary high reflectance, by colored painted bands, columns or whatever, in slightly richer complementary hues.

2. After-Image

The eye tires quickly of any color upon which it is focussed and tends to record, immediately afterward, the complement of that color. If one gazes intently at an orange spot and then looks quickly at white paper, an after-image of pale blue will appear. One of three effects will result from this phenomenon of vision: the second color viewed may be enhanced by the after-image remaining from the first color (as red seen after green), it may be weakened (as pink seen after red) or

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Simultaneous Contrast of Value

All four circles are the same value of gray. The effect of contrasts, seen so vividly in black and white, is also a phenomenon of colors. Dark colors similarly will make adjacent colors appear lighter it may be influenced toward a different but not necessarily unpleasant color (as yellow which is seen after orange).

The effect first mentioned was used at the New York World's Fair where a "Golden Circle" was the first group of buildings seen by the visitor who, arriving by the Long Island Railroad, traversed a long vaulted station en route from train to the Fair turnstiles. To prepare the visitor's eyes to see gold, and yet more gold, the strip windows of the station were washed over with a blue-violet translucent glaze. By the time he had walked through the station the visitor was visually weary of violet and ready to see yellow on any surface which next met his eye.

The second effect mentioned above, the weakening of the second color, is one to be avoided in planning color, and the third, the changing, must be estimated for its probable good or bad result.

Application to industrial work will depend upon the answer to the question; What effect will after-image produce upon the particular problem under discussion? Will a warm or cool after-image be desirable or not? For instance, if a large interior should look cool and spacious, a strong orange in the vestibule to that space will help accomplish the effect. On one occasion a surgeon asked the writer to provide a wainscot in his operating room with a color which should complement the color of fully coagulated blood in order that the surgeon's vision might be relieved and refreshed as he looked up from his work. The blood color turned out to be, not the rich warm red of fresh blood, but a dark purplish red, to which the complement is warm gray green, and the incident underscored the point that, in color, nothing can be taken for granted but must be exactly defined.

At times, no hue at all will be the right solution. For example, workers upon multi-colored artificial flowers should be able to rest their eyes upon a darkish neutral gray, having no hue stimulation, and should find somewhere in the distance a soft blue field which relaxes the close accommodation required for their work.

3. Warm and Cool Colors

Everyone has noticed that colors containing a predominance of red feel warm, that those containing much blue feel cool, and that the former seem nearer, the latter farther away than their true distance from the eye. Red-orange in strong intensity advances most, and blue in light value and weak intensity recedes farthest. Perhaps few people have also observed that only yellow and purple appear to hold their actual position in space. This phenomenon holds true, not only for pure hues but also for delicate relationships in tints, shades and tones. For example, a long narrow room may be visually shortened so that the distance from work-bench to locker-room seems less than it really is by painting the end walls in a dark value of an advancing color like burnt orange or maroon. Conversely, small rooms may be given greater apparent dimensions, so that personnel will not feel crowded, by the use of a light tint of a cool color — pale turquoise, aquamarine, leaf green — for walls and perhaps the ceiling.

Moreover, illusions of a higher and lower temperature may be created by the same means. Recently the writer was asked to correct, so far as color can, the oppressive effects of New York summer heat in a banking room where air conditioning, because of structural limitations, could not be installed. The simple solution of changing the existing tan color-scheme to pale gray-green walls, white ceiling and enameled white columns was voted a success by the bank's personnel. As a by-product, the many young ladies employed there looked prettier against the new background and the colorist took credit for this happy, unplanned result.

PSYCHOLOGICAL ASSOCIATIONS

In addition to the visual phenomena noted above, the architect will want to give attention to certain psychological associations of colors which are not visual but mental. In hospitals, therapeutic color is now standard practice, and the same principles which help to cure sick persons may be used to influence healthy workers. Moving around the spectrum we note that yellow, the color of sunlight, brings good cheer; green has little effect upon human emotions; blue is definitely calming; purple is depressing; red excites to courageous endeavor; and orange is the most powerful stimulant of all. Hues occurring between the six hues named, and variations in values and intensities, furnish material for inducing any psychological reaction desired.

It might be well, in this connection, to clear up the question frequently asked as to how many colors are available in this world. The fact is that colors are far from infinite in number. Theoretically, some 150 hues are discernible by the eye in the spectrum of sunlight. Multiplied by 10 for variations of value in each hue and again by 10 for variations in intensity at each value level, the figure of 15,000 possible colors is reached. However, in practice, a total of 1000 colors is probably the maximum required by any architect. Prepared systems of color chips range from 400 in number, too few to afford adequate choice, to about 1000, which are sufficient for any architect. One of the excellent color systems now available should be part of the equipment in every office. In addition, a dozen or more standardized systems for industrial painting are available from large manufacturers of paint. These have been skillfully designed to strike a general compromise between the solutions of all the problems found in industry, and are a great advance over the dull color schemes to be found in many plants operating today. Unfortunately, since they strive for a compromise, each differs from the others in hues selected and in number of colors. The timid architect will not go far wrong in using one of the systems, though he may miss complete solutions of all his problems.

Returning to the industrial plant, we pick up the matter of choosing colors for their psychological effect. The architect is most interested in the colors which he shall specify for ceilings, walls and floors. Again a bit of theory is necessary before we proceed to the specifications, and again reference must be made to the mechanics of seeing, for the architect's thinking upon which his decisions will be based must work outward from the man at the machine, through the man's immediate surroundings, to the surfaces farthest away.

The first consideration is eye-comfort at the machine. The guiding principles here are: (1) brightness contrasts shall be greatest within the confines of the work in hand; (2) brightness contrast shall then be less between work in hand and its background; (3) that no contrasts farther away shall be permitted to interfere with the first two relationships. In other terms, brilliant illumination upon the object in work is required, slightly less upon the background against which the object is seen, and successive small contrasts against the floor, walls or other surfaces within view. Since light and color go hand in hand, color contributes to the overall effect of brightness contrast, though illumination is the dominant factor. It is the lightness or darkness of color — that is, its value — which assists or prevents the establishment of correct contrasts in brightness. For prolonged concentration in seeing, brightness ratios between task and surroundings should be smaller than 5 to 1, ratios greater than 10 to 1 should be prevented if possible, and ratios in the region of 100 to 1 should not be contemplated.

The floor, which is often glimpsed beyond the working area of the machine, should obviously be light in value in order to minimize brightness contrast. The fact that less light falls upon the floor than upon the machine permits the specification of lighter colors than ordinarily thought to be appropriate, and such colors encourage better house-keeping. The color of the floor will approach neutral as a concession to maintenance, and as a common denominator between other colors.

Walls within the visual field of the worker will follow the principles of brightness contrast mentioned above, so far as value is concerned. They should be of such a value, taking into account their distance, height, orientation and illumination, that slight brightness contrast between them and the machines is maintained. Yet a conflict arises from the fact that as much reflectance of light as possible from the upper part of walls is desirable, within the limit of glare. In some cases of lofty interiors, upper parts of walls may well be white and lower parts in color, but no general rule can be stated. Hue will be determined by the psychological effects desired.

Dados are of great value for industrial plants, though they may be thought outmoded elsewhere. Many a problem of good seeing for the worker can be solved by appropriate dado color as background and as rest area for the eye. And speaking of rest areas, one should make the point that no hue in itself is "easiest on the eyes." Visual comfort comes from properly balanced brightness contrasts, not from any particular hue. Relative values and intensities are the governing factors.

Ceilings, because they are usually situated above the horizontal field of vision and because they usually should reflect all possible light from the sky or interior sources, should be handled differently from any other surface. In most cases they should be white, and should be kept white by repainting at reasonable intervals. However, care should be taken that a bright ceiling does not become a source of glare. If the visual field of the worker be considered to extend vertically about 120° — 60° above and below eye-level — the possibility of encountering glare may be easily calculated.

ESTHETIC CONSIDERATIONS

While the foregoing discussion has considered only the functional aspects of color, esthetic considerations are not to be dismissed. No law of nature or man requires that human activities should be conducted in an atmosphere of depressing color. On the contrary, it has been proven that bright, cheerful, attractive color pays dividends in better tempers throughout an organization. If the average home were to present the dull, forlorn color scheme of many a work-place, a further rise in the rate of American divorces would be confidently expected. This is not to imply that bizarre color-schemes, tossed about at random are to be encouraged. Workers would be the first to apply pungent epithets to them. But simple, appropriate, dignified schemes, as colorful as may be permitted by requirements of good seeing conditions, influence workers whether they are entirely aware of their environment or not. For example, a newspaper press-room in previous days was a horrible example of dingy, unclean, ill-lighted working conditions. The boldest departure from that precedent has recently been accomplished for a great newspaper in the Pacific Northwest, where light beige walls, pale lemon-white ceiling and vermilion columns enclose that magnificent piece of machinery, a 16-unit press, enameled in deep ultramarine blue. An enlightened architect and a generous client gave encouragement to the colorist in planning a scheme which is guaranteed to lift the spirits of men whose job is, at best, noisy and wearisome. Not many industrial interiors would support such a brilliant color-scheme, but mention of it may reassure the faint-hearted.

In any case, rest and locker rooms, cafeterias, lobbies, offices and clerical spaces will permit more interesting, exciting schemes than are now customary. Women's restrooms call for soft peach, rose, soft yellow or pale salmon on walls and ceiling, warm beige carpet and soft lighting. News of such accommodations for personnel gets around among the working population in the vicinity and has been known to attract workers from other plants. The cafeteria may be either warm or cool in hue, depending upon its orientation, and may have peach, rose, yellow or light soft green on its walls, white tinted with the wall color on its ceiling, and a deep value of the same in the floor covering, but no pale blue, violet mauve, nor even white, if management desires personnel to eat heartily.

Private offices of executives present the frequently observed problem of man-attached-to-desk. Moving from the old plant to the new, the majority of executives insist on bringing along the familiar mahogany or dark walnut desk, the matching set of chairs and often the ancient rug. To the design of decent seeing conditions these well-beloved but visually unfortunate objects are serious handicaps. They violate exactly the principles which govern good seeing for the machine operator out in the shop. Many a company officer who attributes his headaches and bad temper to acid indigestion is the victim of brightness contrasts between white paper and dark desk or carpet. If he can be persuaded to buy a new desk or to have the old one refinished to a reflectance of perhaps 25 per cent, something can be done with the rest of the room. A white ceiling, walls of not lower than 50 per cent reflectance and a correct positioning of architectural light sources (above and to the left of his left shoulder, not on the front edge of the desk) may result in his acquiring a sunny disposition and radiating good cheer.

The main entrance lobby to which the public is admitted should obviously exemplify in color, as in displays, the quality and character of the firm it represents. Yet one sees frivolous color standing for integrity and, more often, dull stupid color standing for a bright, lively, up-to-date organization. To strike exactly the right note is none too easy but is worth attempting. Fortunately, the necessity of observing rules for good seeing is not present, since people spend only a few moments there. Drama, free expression, imagination and fancy can be given rein. One can imagine the lobby to a factory making brake-shoes treated in stainless steel and deep blue under the cold illumination of daylight fluorescents, the displays of objects manufactured lit by pale yellow light from filtered sources. Or one can fancy the lobby to a plant where lighting fixtures are made as a pure white dome upon which the colored decoration would come from the intermingling of colored lights cast upward through the apertures of the lighting fixtures on display, arranged for pattern. In a word, the visitor's first impression is important, whether he is conscious of its impact or not, and the lobby should be designed to influence him favorably toward the firm upon whom he calls as buyer or as seller. Color will be an integral part of the attack upon his emotions.

As the visitor progresses from entrance lobby through executive offices to the last machine in the production line, he should encounter a coordinated series of color impressions, each of which is calculated to perform an appropriate function for easy, comfortable seeing, for good cheer and even for esthetic pleasure. Toward the accomplishment of these optimum conditions the wise architect will bring his influence to bear upon the client.

Happily, both will share in the benefits which result therefrom.

". . . anything that will make a plant a more desirable choice as a place to work, and anything that will add a per cent or a fraction of one to the efficiency of the men at work will readily justify its cost. . . ."

Hedrich-Blessing Photo; Norden bombsight plant, The Austin Company, engineers and builders

THE PLANT AS A PLACE TO WORK

By Roland Wank

Associate, Fellheimer & Wagner, Architects and Engineers

LABOR relations, and partly connected therewith, public relations of industry, are critical elements in the struggle for survival of free enterprise. No wonder the architect of industrial plants is concerned that his designs express, and his inventiveness and intuition assist, labor and public relations policy.

It is evident that industry is now engaged in competition for labor, and that for a variety of reasons this condition is likely to persist for a long time, even through depressions. By and large, producers of goods having a high labor content are at a disadvantage in this competition. The needle trades, foundries, brickyards and other enterprises where payroll is a dominant part of production cost generally depended upon foreign and second generation labor which is practically extinct, or sharecroppers and hillbillies who aren't as eagerly submissive as they used to be. Crowding, excessive heat, noise, smell do not appeal to the majority of present-day work-seekers, the less so since millions of them are now familiar with the last word in highly mechanized and partly automatic war production. The brawny son of toil has been succeeded by the self-assured, wide-awake graduate of high or trade schools, even colleges, not looking for manual labor, but rather for the intelligent, semi-engineering tasks of operating precise and powerful machinery.

The more modern industries — especially chemicals, electro-metallurgical plants — which occupy an increasing area of the total national production, may surprise an outsider by the incongruously low number of employees. Sometimes in the vast halls of busily vibrating machinery or in acres of outdoor stills and cracking plants there is not a single workman in view. It is natural that the staff of labor aristocracy in such plants should receive every conceivable facility and convenience, the expense remaining just about untraceable in the cost of the finished product. But even the in-between, assembly-type industries as automobiles, aircraft, appliances, furniture tend under economic pressure toward a steady growth of mechanical equipment, with a corresponding decrease in numbers and increase in the status of labor.

It is evident under the circumstances that anything that will make a plant a more desirable choice as a place of work, and anything that will add a per cent or a fraction of one to the efficiency of the men at work will readily justify its cost within a wide margin — not as a paternalistic gesture of good will, but as a cold-blooded business proposition. What are the physical measures that come within this scope?

Perhaps it would be best to start with some that don't. Proposals crop up here and there in architectural maga-

"Early New England manufacturers must have taken a good deal of pride in their plants, judging by the careful disposition and attractive lines of their many-windowed, tower-topped buildings. . . . The swing toward the contemporary gleaming structure coincided with the growing independence of labor and the critical attention of the public"

Courtesy, The Bettmann Archive

zines concerning recreation grounds at plants, social halls and the like. Experience seems pretty conclusive that workers aren't interested. They want to spend as few hours as possible near their place of work and prefer their recreation elsewhere. Sometimes light lunchtime games like horseshoe-pitching, etc., find some favor, but the insistence of employees to get away as soon as possible led to a steady shrinkage of the lunch period. The original hour was reduced to three-quarters, then half, and is now 20 minutes in many of the mass-production industries, obviously leaving no time for play and creating a paradoxical situation in which management worries about the tendency of employees to neglect their physiological needs, to the disadvantage of efficiency.

Nor does labor like to use meeting places provided by management, no matter how superior they may be to union halls, beer gardens, or school auditoria.

Broadly speaking, three categories of physical provisions may be discerned as factors in employee relations.

The first category is one of which employees are thoroughly conscious, and on which they are insistent. Involved are mainly saving the employees' own time and items of physical comfort. Ease of access is prominent in this group: adequate parking near the place of work, or rather, near the time clock where pay begins; short walk from parking space or other transportation to the locker room or place of work (and with the general imminence of portal-to-portal pay, employers will no doubt be as concerned with this feature as labor. Good locker rooms, with ample space to handle rush periods, distributed for easy reach from work spaces and from places where employees may eat lunches brought from home and stored in the lockers, are next in line. Sanitary facilities must likewise be close to places of work in the mutual interest of employer and worker; showers are taken for granted for hot or dirty work and often demanded by other workers also, women and younger men being particularly interested in freshening up for social activities after work.

Cafeterias must be close at hand for the shortening lunch period, and must have enough counters to eliminate long waiting lines. This item, too, is of mutual interest to workers and management; the latter, having become aware of the effect of good nutrition upon efficiency, prefers that employees shall make full use of the balanced, hot meals offered, and that they shall not be rushed into gulping their food by loss of time in waiting. Even under ideal conditions, however, many employees prefer to bring their lunches and space must be provided for them, with perhaps partial service (as coffee or ice cream). Women workers are often furnished with a kitchenette adjoining the main rest room, which has gradually blossomed out with cheerful upholstered pieces and fabric curtains, in spite of reports of occasional carelessness or vandalism.

Other less keenly contested items in this first category are daylighting and ventilation. The modern plant must, of course, provide adequate artificial lighting; yet the psychological need for contact with the outside world is attested by the indicator devices used in some blackout plants which keep shut-in workers informed about the weather outdoors. Good ventilation has become a matter of course. And it is conceivable that air conditioning will eventually become a requirement, especially in the hotter climates, having already been installed in many departments as an aid to certain production processes, in office and medical wings attached to plants, as well as in officials' dining rooms and clerical cafeterias from which it tends to spread into general employee cafeterias.

The second category includes features with which employees are not so vocally concerned, but which are important to management from the point of view of safety, efficiency or legal responsibility. In lighting and ventilation plant designers are likely to set their standards much above the point at which workers would become critical. Health and medical departments are geared not only to deal with accidents, but to prevent them by initial and periodic examinations of employees and constant surveillance of the premises. Spread of contagion is minimized by checking the condition of employees returning from sick leave, and many plants

Hedrich-Blessing Photo; Willow Run plant Ford, Albert Kahn Associated Architects and Engineers, Inc.

install complete diagnostic and treatment facilities, sometimes including dispensaries, to cope with all aspects of service-connected disability. This may be motivated in part by the intent to reduce liability in compensation cases; to a much larger extent it is done to offer the very best service available, in humanity toward the worker, and also to return him more quickly to his post.

Beyond these two categories lies a third type of attack upon the problem of labor relations, along with public relations in general: to evoke in employees a feeling of pride and personal attachment toward the plant, and by the same token, attract desirable job-seekers and impress the general public. As in all other phases of labor and public relations, design can offer important contributions.

Early New England manufacturers must have taken a good deal of pride in their plants, judging by the careful disposition and attractive lines of their many-windowed, tower-topped buildings. In a later, perhaps more competitive era, plants were apparently regarded as unavoidable encumbrances, without character or dignity of their own and hardly even kept clean like other tools of production. The swing toward the contemporary gleaming structure coincided with the growing independence of labor and with the critical attention of the general public, which frequently found legislative expression.

One of the more recent devices in bidding for public favor is the opening of plants for public inspection, often including regular guided tours, to show attractive working conditions, efficient production and painstaking devotion to the excellence of the product. Of course, this device can be used only where the plants are already bright and up-to-snuff; in turn, the institutionalization of public inspection serves as an incentive for further improvements of plant design and housekeeping.

The physical features which will evoke pride in employees and approval in the public begin with the very location of the plant, often in open, green country. Site planning for impressive views and landscaping to emphasize or hide parts of the layout follow with their contributions. Treatment of fences, drives, parking spaces and architectural appearance complete the exterior effect.

In the interior layout, the public relations program will require an impressive reception room, matched from the labor relations point of view by an employee entrance which should be just as bright and dignified and perhaps just a little bit luxurious. Both spaces usually carry a display of company products, often accompanied by highly informative material on the place and contributions of the industry in the national picture.

For the visitors, the reception room should be the starting point of a tour designed to convey a cohesive impression of operations, and emphasizing the best points of employee facilities. The tour should be designed into the plan at the start, since it is essential to avoid interference with plant traffic, distraction of employees at work, or exposure of visitors to hazards.

For employees, a parallel program of orientation is often included in training courses, intended not only to stimulate their pride in the company but also to inform them of the opportunities to find the work most congenial to them and for advancement. This requires classrooms or small auditoria, already mentioned in connection with safety education.

In addition, many industries maintain showrooms and sales suites for distributors and dealers; some, like the automobile and clothing industries, sometimes devote extensive floor space to retail sales as a matter of public relations — catering to a widespread consumer preference to shop at the very source.

In conclusion, it might be said on the basis of some experience, that the architect is exceptionally well qualified to advise the industrialist on matters within the scope of this article. Because he is a member of the consuming public himself and deals professionally with clients drawn from so many walks of life, his notions on how people react to features of plant layout and building design are often more dependable than those of the plant management or even those of single-minded labor or public relations advisors.

EMPLOYE CAFETERIAS

How to Plan for Seating and Service Requirements

By Arthur W. Dana, Restaurant Consultant

Employe food services, whether for office, industrial or department store workers, have usually justified their original installation in a number of ways. Among other things, such services help boost workers' morale by providing increased convenience and accessibility, reducing congestion during lunch periods, and making it unnecessary for them to leave the premises for lunch.

Now the trend among business and commercial organizations to relocate their headquarters in suburban areas has made the provision of employe food services a necessity for companies which formerly, perhaps, did not have to be concerned with such matters. In suburban locations, where normal facilities are fewer and more widely dispersed than in urban areas, the factors cited above become increasingly important.

Effective and efficient layouts of employe food services, as outlined in this article, will require much preliminary discussion with the client as to objectives and policies that affect the proposed food service and the accompanying employe morale goals. This article will review the basic elements in planning such installations, and will summarize special requirements for suburban commercial or business organizations. While these requirements are, on the whole, identical to those for employe facilities in urban installations, there are a few new elements which suburban relocation introduces. These will be suggested below.

SEATING REQUIREMENTS

The determination of cafeteria seating requirements by the architect depends upon several considerations relative to the size of the organization, company policy and physical limitations. For example, company policy as to the exact use of facilities by employes (price of the food, restrictions against eating elsewhere, or absence of such restrictions) helps determine the ratio of the total number of employes who can be expected to use the facilities. The proportion which will use the facilities at any one time is determined by such factors as (1) the number of "staggered" shifts which are provided; (2) the intervals between the start of each of these and the extent of their overlapping (by reason of seat occupancy time); (3) the length of the lunch period (each shift); and (4) the speed and efficiency of counter services. Determination of seating capacity which must be provided affects the total space requirements of the installation, both for the seats and tables themselves, aisle space, adequate counter facilities and space, and sufficient kitchen space.

Ratio of Patronage

Where companies furnish meals to their employes at a nominally low (flat) price, a 90 to 95 per cent patronage ratio may be expected. Where employes must pay higher prices for the food, but are not permitted to eat elsewhere but in the company-provided facilities, seating for 90 to 95 per cent must be provided, although 20 to 25 per cent of these will probably bring their own lunches, supplementing them only with beverage and sometimes dessert from the counter. When no restrictions are placed on the employes in this respect, but the prices are not exceptionally lower than elsewhere, a range of 50 to 75 per cent patronage can be expected. This depends, however, on the length of the meal period, the existence or absence of long waiting lines, quality and price or value of the food, attractiveness of the facilities and the comfort of the seating. Remoteness of the store or offices from public restaurants and parking difficulties near public restaurants are other factors which can lower or raise the patronage ratio.

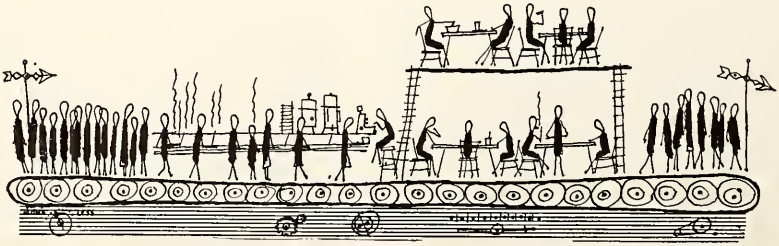
Staggered Meal Periods and Effective Serving Times

The trend toward shorter luncheon periods appears to become stronger where employe food services are installed, with the minimum period frequently being 30 minutes, or in some instances 45 minutes. In a 30 minute period, the maximum available or effective time for serving patrons is within the first 7 to 8 minutes, leaving approximately 20 minutes for dining, etc. In the case of 60 minute periods the effective serving time is within the first 12 to 15 minutes. Wherever problems of management and interrelationship of departmental functions do not cause excessive complications, it is desirable to stagger employes' meal periods, preferably on a 10 minute minimum headway. Some companies are able to stagger periods on a 5 minute basis, but this may lead to excessive overlapping, because of delays in the use of washroom facilities and in traveling to and from the cafeteria.

The whole cycle may start at 11 A.M. or 11:30 A.M. and last until 1 P.M., providing as many as nine to twelve 10 minute periods. Department store employes are frequently served luncheon as late as 2:30 to 3 P.M. In very small operations serving 100 to 150 persons, a 10 to 15 minute break between each two shift periods may be of value. This will permit the cafeteria operator to replenish, clean up and prepare for the next group. In larger operations, this break may be unnecessary, especially if the patrons buss their own soiled dishes (see below).

Elapsed Time of Seat Occupancy

In a 30 minute lunch period, the minimum time of seat occupancy is 12–13 minutes. Maximum for such a period would be 20 minutes, and this figure is allowable for part of the computation process. In longer periods, most office



Drawing by Don Ervin

Joseph W. Molitor

workers prefer to leave their tables after about 20 minutes to stretch and walk about. Department store workers, however, many of whom stand during much of their working day, are likely to remain seated for longer periods, unless other adequate lounge facilities are located nearby.

In a 45 minute luncheon period, the range of maximum seat occupancy is likely to be from 20 to 30 minutes, while in a 60 minute period, the range may be from 20 to 45 minutes.

Seating Requirements and Counter Speed

Suburban employe food services, particularly because of their usual location fairly far from public eating places, need to have effective counter speeds for optimum efficiency. Conventional cafeteria counters from 20 to 30 ft long have "speeds" of from 5 (sometimes less) to 6 persons a minute. This may be increased to a more satisfactory 7 or 8 a minute by introducing several modifications. "Free-flow" counters such as described below can accommodate from 10 to 30 per minute or more.

Additional Seating Functions

Planning of the cafeteria area is sometimes affected by the need to provide for seating functions other than the normal ones. The inclusion of private or executive dining areas is dependent upon management policy. Where there has been no previous food service, it is well to caution the client about certain "human relations hazards" in limiting the use of such areas. On the other hand, if the dining area has some flexibility, or if sufficient space is available, a small private dining area may be useful for entertaining special guests, officials and the like at conference luncheons.

Similarly, requirements for occasional banquets or multiple use for departmental meetings may affect table arrangement or layout of the room. Public and community relations of the company in a suburban locale may also influence this phase if the area should be made available to civic groups at any time. Additional lounge facilities are usually desirable only where 45 to 60 minute luncheon periods exist, or where mid-morning or afternoon rest periods are customary.

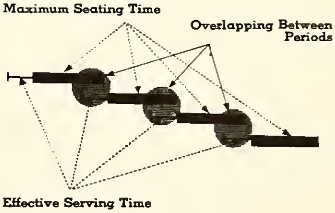
SERVICE REQUIREMENTS

In planning for maximum efficiency and comfort in company cafeterias, the architect must be cognizant of a great many factors, including details of the actual management of the installation. Preliminary decisions on such matters can directly affect layout and spatial requirements. The manner in which foods are displayed and served, location of various categories of foods in relation to each other, decisions concerning the employment of pre-packaged sandwiches, etc., decisions as to whether or not patrons will be required to carry their own soiled dishes to service windows — all these have direct bearing on the size and nature of the facilities the architect must design.

Free-Flow Counters

Perhaps the most important of these considerations are the arrangement and location of serving counters. Frustrating delays in waiting lines at counters are an important factor in reducing both patronage ratios and employe morale benefits. The conventional counter is a series of cumulative bottlenecks — hot food serving station, made-to-order-sandwich station, drinking water, condiments, coffee service, cashier station. These impede traffic flow and slow the line. When desserts are displayed above salads, for example, this arrangement can slow traffic. Serving speed can be increased, however, from 5 or 6 per minute to 7 or 8 per minute per cafeteria line by such devices as placing the hot food counter first in line, using ready-wrapped sandwiches, locating water and condiments at a stand in the dining area, and placing the cashier's stand about 12 ft from the coffee station, which should itself be last in the line. Since usually only $\frac{1}{3}$ to $\frac{1}{2}$ of the patrons will take coffee at noon, it is desirable to let those who prefer milk or iced tea by-pass this station.

Still greater increases in serving speed can be made by substituting a "free-flow" counter, such as that shown in Fig. 1, for the conventional serving counter. This arrangement permits those who wish cold food to by-pass queues at hot food or sandwich stations. Similarly, those who do not wish desserts can by-pass this station (only 65 to 75 per cent of the patrons usually buy desserts).



To expedite such by-passing, a traffic aisle 6 to 10 ft wide has to be provided. The free-flow counter with remote cashier stations can have a speed of 10, 20, 30 or more per minute, depending on the number of hot food stations provided and the linear display of quick-pick-up foods. Lengths of such counters may range from 40 to 70 ft or more. Advantages of the free-flow system include elimination of duplications in counter equipment (as in multiple counter lines) and reduction of the service staff. In actual practice no cross-traffic problems have been encountered in by-passing, if the counter is properly designed. The free-flow counter depends for its success, however, on a fairly even flow of patrons into the cafeteria and a probable patronage distribution of *at least* 25 per cent for salads and ready-wrapped sandwiches. Separate snack bars or cold food lines are economically justified only in larger food service installations, but these can be incorporated in the free-flow design without duplication of dessert, beverage and cashiering facilities.

Besides the arrangement of the serving counters themselves, an important element in potential service delays is replenishment of foods at the counters, particularly at the hot food station. To reduce delays from this cause, it is desirable to plan pass-through facilities from the kitchen to storage cabinets for both hot and cold foods. Wherever possible, these should be designed so that there is a minimum number of steps from the hot food production facilities to the reserve warmer.

The location of the serving counters should afford some space for a waiting line-up. Screening or partially concealing both the serving counter and the line-up space from the view of the diners is sometimes done.

Still another factor which affects the architect's planning is the method by which soiled dishes are bussed. The increasing practice in employe cafeterias is for patrons to carry their own trays of soiled dishes to a pass-through window, conveyor belt or shelf. This procedure has the advantage of freeing tables and seats as soon as the patron arises, thus reducing somewhat the total number required. The procedure also encourages diners to keep their plates on the trays while they eat, and this habit, in turn, makes the use of rectangular rather than square tables desirable, so that the trays (usually 18 by 14 in.) will fit on a table 30 in. wide and with a length of 2 ft per seat on each linear side. Other advantages to having patrons buss their own dishes are decreased labor costs (one bussing employe is needed for each 50 to 60 seats), decreased breakage of china and glassware, and elimination of scraping and stacking of dishes in trucks located in and around the dining area.

The Menu Pattern

The menu pattern, the approximate portion sizes to be served, and estimates of distribution of sales between salads, sandwiches and hot foods, are factors which the food service equipment specialist or consultant must transpose into equipment sizes or capacities and numbers of equipment items. The ratio of men and women patrons, and a considerable ratio of older people who must watch their diets, are among the factors that will influence the estimates of proportionate facilities for hot foods versus salads and sandwiches. The menu pattern that is limited to one, two or three hot plates will affect the maximum loads on roasting, frying, kettle or range top equipment.

To the extent that the menu pattern avoids an excessive variety on any one day, the economic subsidy or burden inherent in employe feeding will be lessened and the quality of the food will be improved by faster turnover and opportunity for better supervision of preparation.

SPECIAL SUBURBAN PROBLEMS

Suburban locations may reduce the frequency of deliveries of meats and produce from a daily basis to two or three times a week and thus require slightly larger storage refrigeration and freezer space. Other perishables are usually on a daily basis. In suburban department stores the frequency of night operation is often greater than in the city, hence, the necessity to provide for two meals a day will increase refrigeration needs.

If the cafeteria is located near urban centers, meats may be made ready for cooking by the dealers, thus limiting the butchering or meat-cutting equipment which has to be provided for kitchen areas. Suburban department stores may require additional baking equipment, because of night operations, but would need very little more kitchen capacity; baked goods can be prepared in the morning for service at night, whereas most kitchen preparation would be freshly made for the evening meal.

Similarly, baking of pies and cakes may not be done, in favor of purchased products. However, it is safer to allow space for possible future baking, including that of rolls or biscuits. Bread is almost always purchased.

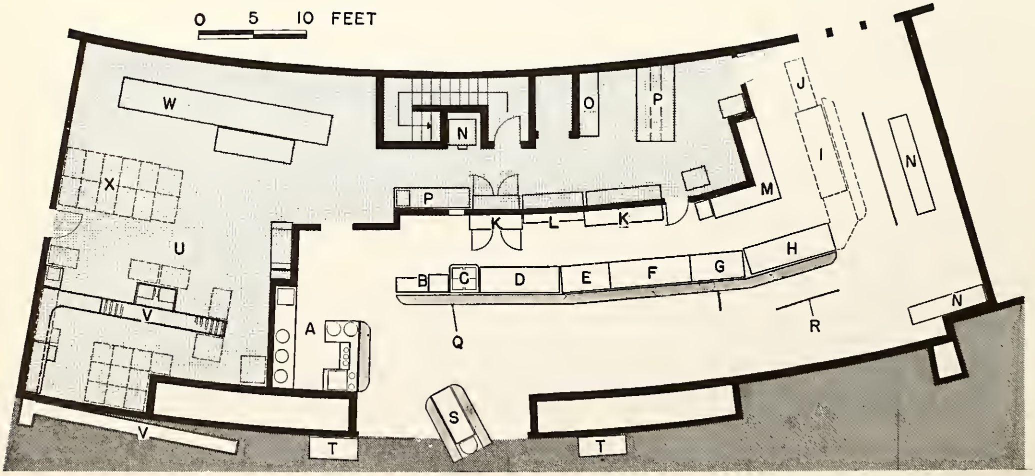
FIG. 1

Free-Flow Serving Counter

A — HOT BEVERAGES
B — MILK
C — ICE CREAM
D — DESSERTS
E — SANDWICHES & SOUP
F — SALAD
G — BREAD
H — HOT FOOD

I — FUTURE HOT FOOD COUNTER
J — FUTURE TRAY & SILVER STAND
K — PASS-THROUGH REFRIGERATOR
L — PASS-THROUGH CABINET
M — PASS-THROUGH WARMER
N — TRAY & SILVER STAND
O — SINK
P — WORK TABLE

Q — TRAY SLIDE
R — GUIDE RAIL
S — CASHIER
T — WATER & CONDIMENTS
U — DISHWASHING AREA
V — CONVEYOR
W — DISH MACHINE
X — DISH TRUCKS



DESIGN OF FACTORIES

Review and forecast by members of Albert Kahn Associated Architects and Engineers, Inc.

PERSONNEL FEEDING

The planning of food facilities depends closely on the scheduling of employee time for meals

The relationship of proper feeding to production efficiency has been conclusively established by various detailed studies of the subject, and as a result the time seems not far distant when the average worker may be better fed in the plant than at home. This is already true in some war plant communities with emergency housing or trailer camps as the only available dwellings. In some such localities, with inadequate home cooking facilities and the further complications of the point rationing system, workers are eating not only lunch, but breakfast, and dinner as well, in facilities provided within the plant.

Instead of being treated as a minor matter, therefore, industrial feeding warrants close study of existing facilities or projected new facilities to determine their adequacy for an efficient postwar organization.

It was general practice formerly to designate some nonproduction area in the plant as a cafeteria or dining room and have equipment manufacturers submit plans and bids. Since each manufacturer was interested only in the sale of his own product, this practice had the obvious fault of failing to bring the over-all feeding scheme of the plant into one unified pattern.

Carefully vented battery of ranges in the view below is to be seen again in the background of the view above. The size of the plant kitchen depends on the size of the total work force and not, like the dining rooms, on the largest shift

The first and most important test to apply against any projected plan is this:

Are the facilities close enough to employee work stations, and are they of sufficient size and number so that employees can walk from their work stations to the dining room, stand in line at the cafeteria counters, eat their food at a dining room table, and return to their work stations within the time allowed them for their complete meal period?

To get this information, especially on large projects, a dimensional plot should be drawn of the entire factory showing the approximate number of employees in the largest shift in each area. It is also necessary to know the length of time allowed for meals and for the complete meal period. (The latter should, generally, not exceed 90 minutes.)

The number employed on the *largest* shift, the location of their work, the length of their mealtime allowance and the over-all mealtime, determine the size and location of dining rooms and the required equipment.

The total number of employees in *all* shifts determines the size of the kitchen, the store rooms, refrigerators, toilets and locker rooms, and other similar employee facilities.

Unless the meal period is at least 30 minutes long, cafeterias and dining rooms should not be considered. Where they are not used the burden of house cleaning on the production floor and around the plant is increased. For the sake of better housekeeping, some industrialists would like to dispense with the food carts sent through some plants at given intervals. Studies have indicated that in many instances these portable carriers provide the only breakfast that is eaten, and to dispense with them would seriously hamper production efficiency.

Experience has shown that where a plant employs overlapping shifts, an average of 75 per cent of total employees will patronize the plant eating facilities. By providing facilities for the total number on the largest shift, a margin is provided therefore to clean tables between shifts and to provide for those who linger and smoke after their meal.

Separate facilities should be provided for the hourly rate men and the office workers not for any reasons of class or caste, but because of the hazard of dirty work clothes.

One of the commonest faults in industrial cafeteria installations is failure to provide adequate space for unboxing of food, bottle crate storage, garbage refrigeration, and other space-consuming "incidentals." This is sometimes so serious as to interfere with the orderly preparation of food, and any holdup on the cafeteria line may result in production time waste far greater than the expense of properly planned and adequate storage areas.

The dining room plan should include not only a layout of cafeteria counters, but of necessary silver sections, water fountains, glass racks, service stands, cash registers, change machines, ventilation equipment, and the like.

The total cafeteria area per employee will average from 10 to 12 sq. ft. exclusive of the kitchen. It is generally possible to accommodate more people at square or round tables seating four than at long tables or benches.

The accompanying views show typical industrial installations with varying service facilities in arrangements which are orderly and modern.

While the manufacturer provides eating facilities as an integral part of his plant, there is a growing disposition on his part to lease out the operation of it to a food concessionaire. It is frequently run by the manufacturer at a loss, and particularly in these war times the average industrialist has been beset by so many problems that he is anxious to avoid taking on the additional headache of feeding. What the ultimate trend here will be is not yet clearly indicated.

1. *Stair to employee toilets in basement occupies minimum space.* **2.** *Alternate arrangement: facilities in mezzanine, materials or tools below.* **3.** *Access tunnels must be wide enough for trucking.* **4.** *Lockers and wash fountains*

EMPLOYEE FACILITIES AND CIRCULATION

Efficient production demands that employee facilities shall not simply be placed in "space left over" but planned for the best use of time

We believe the production floor should be kept as clear as possible of all non-production obstructions for the sake of cleanliness and adaptability and flexibility. Toilets on the production floor may stand in the way of a needed new conveyor, and lockers may block the path of a projected new production line. The necessary corners and angles formed by lockers and similar facilities are also dirt catchers and elimination of them reduces the housekeeping burden on the production floor.

Sometimes because of rock, ground water, or other soil conditions it is not practical to provide a basement. In such cases we recommend locating employee facilities on a mezzanine and bringing the men down to the production floor instead of up from the basement. A mezzanine layout follows the same essential pattern as the basement design shown in the accompanying illustration.

The reason we prefer a basement to a mezzanine is that to get necessary clearances it is generally advisable to go so high with the mezzanine that considerably more steps are required to reach toilets and lockers located there than in the basement. Not only are the extra steps fatiguing to the workers, but it should also be kept in mind that if

Pedestrian walkway off the production floor. "It was found desirable to add a shield along the inner side to prevent swirling skirts above from offering too much distraction"

conveniently located facilities can reduce by only one minute a day the time spent by a worker in going to and from toilets, the sum total of savings in a plant of 6,000 men adds up to 100 hours a day which would otherwise be non-production expense.

The ideal basement layout will have one or more main tunnels similar to that shown in view 3, previous page. Tunnels this size provide not only for heavy pedestrian traffic but can also serve as a driveway for low clearance platform trucks to deliver food to the kitchens and remove garbage.

While few plants will require a tunnel of this width, the main underground corridor in any plant should similarly be flanked by doors and entrances to cross-corridors, locker and wash rooms, cafeterias, toilets reached by stairway from the production floor and stairways to various departments above so that employees can reach their work stations without cross-traffic and the resulting confusion on the production floor.

Whether time clocks should be located at the outer ends of the main tunnel, in the locker rooms, or upstairs on the production floor is a controversial subject which will be determined by management at each individual plant. It is our opinion that management in general prefers to have the time clocks located in each production department and punched just before the worker goes on his machine.

Entering the tunnel, the employee goes first to the locker room, the first doorway to the left shown in view 3, previous page. An ideal locker room arrangement is shown in view 4, previous page, with the row of lockers on the right duplicated on the left. The distance between the double row of lockers, where the Bradley wash fountains are located, is 16 ft. A minimum distance of 9 ft. should be provided from center to center of the fountains. Each fountain accommodates 10 men at one time, and one fountain is adequate on the average for each 100 employees.

Only limited toilet facilities are provided in the locker area, employees using mainly those toilets which are located near their work stations. Similarly, only limited wash facilities are provided in the local work station toilets, usually not more than one or two wash basins, since workers prefer to do their main washing in the locker room just before leaving for home.

Various types of lockers are available, and in some modern plants workers even hang their clothes on poles attached to racks on the main production floor, the racks then being hoisted to the ceiling until the end of the shift. It is desirable to provide one locker, or at least one locking compartment, for every employee on the payroll. Necessary locker room space averages 3-4 sq. ft. per employee.

The question of showers is still in the debatable stage. Experience so far shows generally that the demand for them is greater than the use. Unless a production operation is particularly dirty, such as some types of foundry work, workers will not stop at the end of a shift to take a shower and then get back into their work clothes. They want to get home, get a shower there, and get into clean clothes.

It has been extremely important in wartime, and may be so to a lesser extent in peacetime, to provide flexibility in toilet facilities for men and women workers. Partitions should be so designed that they may be easily switched to provide accommodations for the different sexes in direct ratio as the proportion of workers changes.

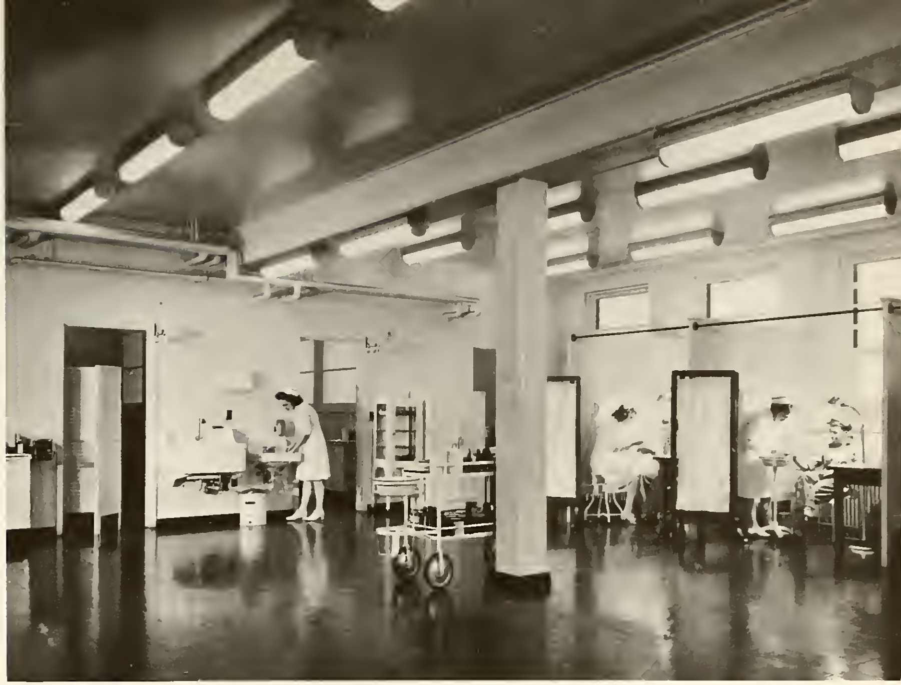
The number of individual toilets to provide is generally regulated by building codes. Where no other regulations prevail, it is prevalent custom to use the New York State code which seems reasonable and fair. It requires one toilet for every 20 women and one for every 25 men in plants of limited size, with certain increases in these ratios as the number of employees gets up into the hundreds and beyond.

As a general rule, toilet rooms should be so frequently spaced about the plant that no worker need walk more than 200 ft. to reach one—again to effect the time saving mentioned earlier. Time lost to production in going to distant toilet rooms costs much more than the expense of an additional installation.

Methods of locating toilets vary widely. As stated, we recommend locating them in the basement area where they may be reached by stair entrances such as is shown in view 1, previous page. This method provides a minimum of obstruction on the production floor.

Where employee facilities are located on the mezzanine, toilets spacing is similar to the basement spacing. This practice is shown in view 2, previous page. A further variation of this method is to locate a tool crib on the production floor in the area below the toilet. Both methods have the obvious disadvantage of requiring a fixed stairway and overhead obstruction which may interfere with a desired change in the plant layout at some future date.

Supervision over the use and abuse of toilet rooms as lurking places for loafing or play is worth considering in the light of experiences which factory management may have had. We are inclined to think that toilet rooms located below the floor levels are more easily supervised.



FIRST AID AND HEALTH

In some recent instances the industrial plant has installed a complete hospital in miniature, but usually needs less

Closely allied with other provisions for personnel are the plant first-aid and hospital facilities. No hard and fast rules can be laid down here because of the many variable factors and because of the differing ideas of industrialists on the subject. Among recent installations the size varies. from accommodations having nearly the completeness of a small general hospital, with full-size hospital beds, down to facilities containing practically all available equipment in an individual room.

Local first-aid provisions throughout the plant will likewise range from suspended wall cabinets to small rooms with space for the injured worker and an attendant. Where a plant is located far in the country, out of the vicinity of a local general hospital, an operating room may be desirable, but as a general rule it would seem preferable to utilize community facilities.

One or two cots where injured workers may rest before going home are desirable and should be generally ample. The hospital, of course, should be so located that a worker returning for treatment need not pass through the production area. The hospital should likewise be located adjacent to the personnel department so that new employees may be given a physical examination upon being hired. This may require X-ray and dental equipment, according to the completeness of the examination given. This is based on factors in labor relations, such as time loss and compensation reduction, and reduced labor turnover.

The view shows a fairly complete first-aid installation.

BASIC ELEMENTS IN THE PLANNING OF ELECTRICAL SYSTEMS

By Felix B. Graham
Chief of Electrical Department
Syska & Hennessy, Inc.,
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INDUSTRIAL BUILDINGS

A MODERN industrial plant probably requires more electricity per unit area than any other type of building. The demand varies with the type of plant and ranges up to 30 watts per sq ft. The function of the distribution system is to receive energy in a large bulk at one point and to break it down reliably into small, safely usable quantities. Such a system must have certain characteristics stated in the following order of relative importance: (1) safety, (2) reliability, (3) flexibility, (4) expansibility, (5) durability, (6) low maintenance cost, (7) low initial cost, (8) small space requirements, (9) appearance.

Reliability in an industrial plant is next to safety in importance because interruption of the power supply is extremely costly due to lost time and production. In certain processes, an interruption spoils a partially completed product which must be removed from the processing equipment at great cost and disposed. Flexibility is important because the nature of many industrial plants requires constant changes and relocation of equipment. Appearance promotes good housekeeping.

Short Circuit Protection

Because of the size of load and requirements of reliability and flexibility, the distribution system of an industrial plant is complex and requires well-planned safeguards. The term *interrupting capacity* is a frequently used term, and it might be well to discuss its meaning briefly.

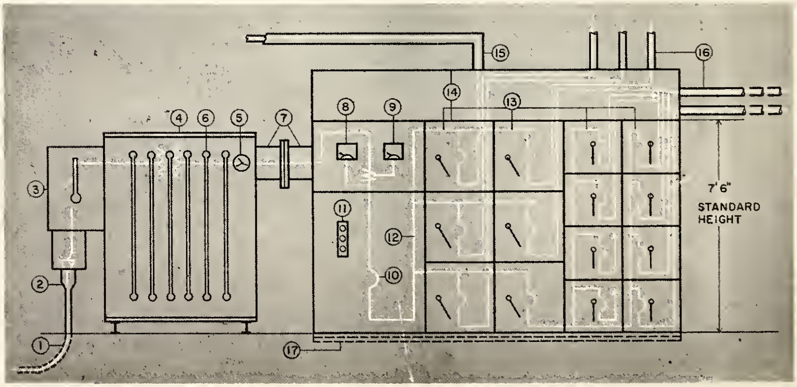
The arch-enemy of an electrical system is the short circuit. When two or three wires of different phases touch or one wire makes contact with ground, then there is a path of resistance smaller than through the equipment normally supplied. At that moment all power generated on the supply system as well as that back-fed from motors in the plant tends, theoretically, to rush to that point. This tendency is limited by the impedance (resistance) of the electrical system which is set up by the conductors and transformers. Impedance becomes smaller as (1) the conductor becomes larger, (2) the conductor becomes shorter, (3) the transformer becomes larger. And the smaller the impedance which is set up in the path of the current, the larger will be the current that flows. Where large banks of transformers exist and a short circuit develops close to the supply point, the available short circuit current can be extremely large. This current must be interrupted by the opening of a circuit breaker, an operation which is accompanied by tremendous forces acting on the mechanical parts of the breaker. Yet, the breaker must be able to interrupt the current without damage to itself. This is the meaning of *interrupting capacity*. It follows that the breakers closest to the supply point must have the greatest interrupting capacity; those further away may get smaller and smaller.

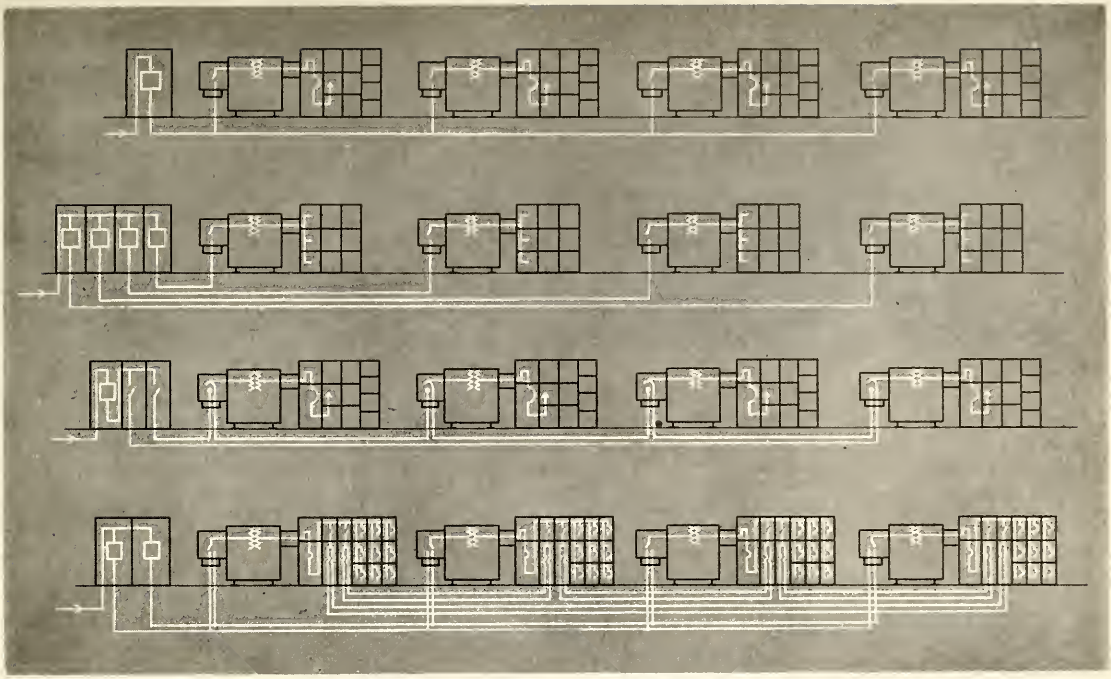
Transformers

A *transformer* changes the magnitude of the voltage and, with it, that of the current. For instance, if the voltage is doubled, the current is halved. With the current halved, the wires need only be half the size. Since copper is the most expensive part of a long distribution system, the economy of high-voltage distribution is apparent. Considering a large plant, current is transmitted over the utility company's lines at very high voltage (from 22,000 to 115,000 v or more). The first bank of transformers steps this down to voltages which can be safely distributed through the plant

COMPONENTS OF A UNIT SUBSTATION

1 **Incoming Primary Feeder**
2 **Pothead**
3 **Primary Disconnecting Switch**
4 **Transformer, Askarel Filled**
5 **Askarel Thermometer**
6 **Askarel Radiator Tubes**
7 **Connecting Throat**
8 **Voltmeter**
9 **Ammeter**
10 **Secondary Main Breaker**
11 **Operating Buttons**
12 **Main Bus**
13 **Feeder Breakers, Draw-out Type**
14 **Pull Box (Head Box or Crown Box)**
15 **Outgoing Feeder Bus Duct**
16 **Outgoing Feeder Conduit**
17 **Floor Channel**





PRINCIPAL DISTRIBUTION SYSTEMS: 1. Simple Radial *All unit substations connected to the same primary feeder. Least expensive. Feeder fault at any point makes entire plant inoperative. Still suitable for many plants.* **2. Modified Simple Radial** *Each substation has a primary feeder. Secondary breaker is omitted (each primary feeder is protected by its own breaker). Feeder outage will affect only area of plant supplied by one substation. Cost exceeds 1 by about 20 per cent.* **3. Looped Primary** *Another way to limit feeder fault to one station. Cost exceeds 1 by 5 per cent.* **4. Primary Selective, Secondary Network** *One of the most reliable systems. Since the secondaries of substations are connected in a network, the entire system works as one unit. If one transformer or primary cable is faulted, service to the affected station is maintained through the others. Voltage stability is good since all transformers work together. Plant expansion is handled with relative ease. Cost exceeds 1 by 50 to 70 per cent.*

(2300 to 13,000 v). The transformers next in line which ideally should be located right in the utilization areas step voltage down further to that required by the equipment (120 to 480 v). We have, then, three voltages: (1) *transmission voltage*, (2) *distribution voltage*, (3) *utilization voltage*. Other voltages are usually also required for special applications.

There are basically three types of *transformers;* (1) *dry type*, (2) *askarel filled*, (3) *oil filled*. The difference is in the types of cooling medium.

The *dry type* depends on air for cooling. It has the advantages of light weight, safety, minimum maintenance and clean-cut appearance. Its disadvantages are: limited capacity to withstand lightning surges transmitted from the overhead system, and sensitivity to dusty atmosphere.

The *askarel filled* transformer uses a non-hazardous liquid for cooling. It is safe, stands up well to lightning surges and is not affected by wet, dusty or most of the corrosive atmospheres. But it is heavy and requires some maintenance.

The *oil filled* transformer has characteristics similar to the *askarel* filled with the exception of safety. Since the cooling oil is flammable it must be installed in a fire-proof vault when used indoors. Its initial cost is lower than that of the other two. All transformers emit heat and work more efficiently when well ventilated.

Switchgear

Switchgear is a collective name for the devices used for switching and protection of the main and feeder lines. *Primary switchgear* is on the high voltage side of the transformer and is used to select one of the two or more supply lines or to take the transformer off the line when work has to be done on it.

Secondary switchgear is on the low voltage side of the transformer and protects the feeders against short circuits and overloads.

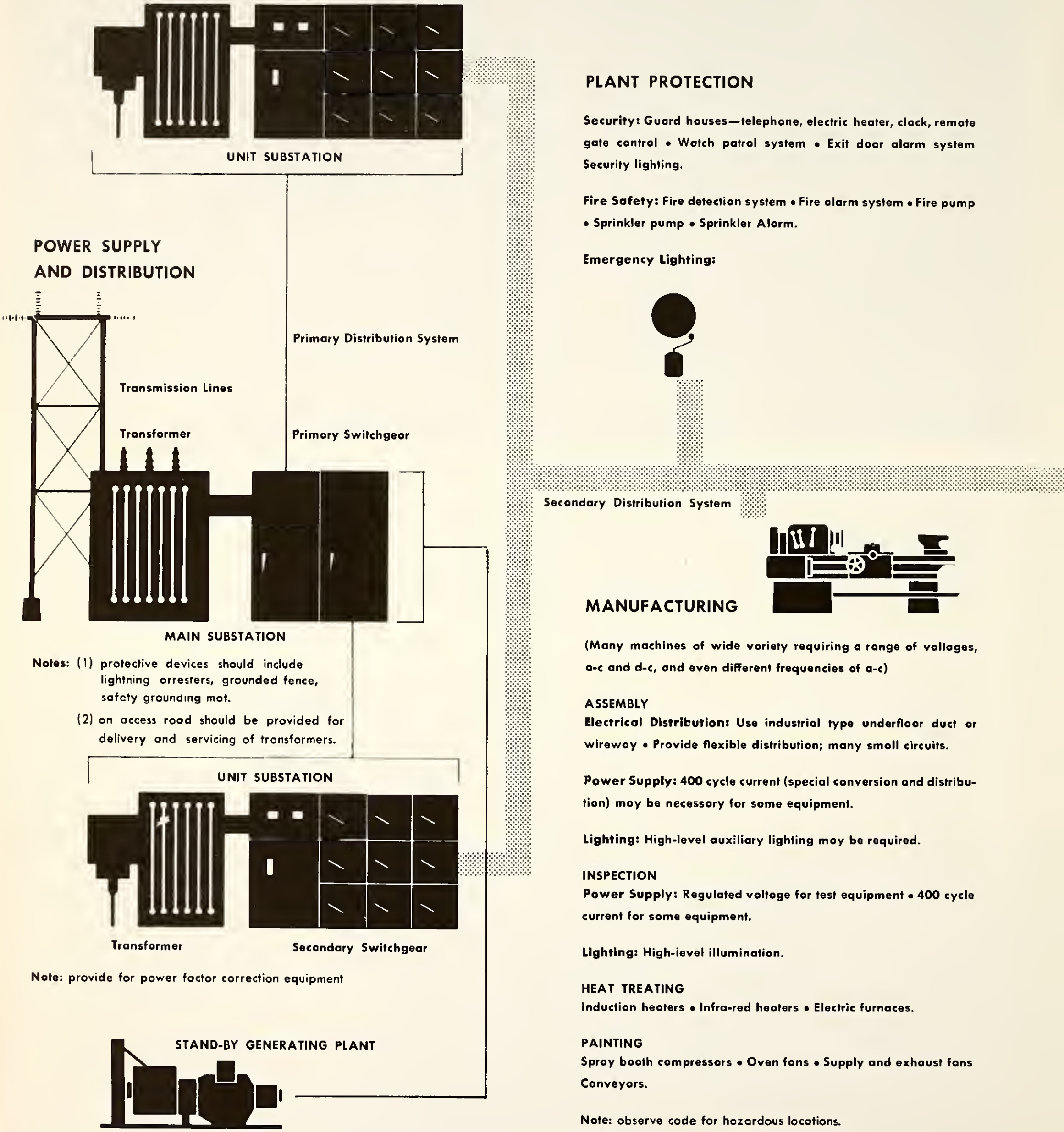
Switchgear can consist of either *circuit breakers* or *fused switches*. In industrial plants circuit breakers are desirable because they afford better protection to three-phase motors than fuses, and service can be more quickly restored. Modern switchgear is completely metal enclosed for safety, and is often arranged so that breakers can be drawn out or lifted out easily for inspection or maintenance.

Voltage Regulation, Power Factor

The voltage of an electrical system varies with the load; the greater the load the lower the voltage. Most motors and lighting operate satisfactorily within the complete voltage range normally encountered. However, there are certain types of equipment, notably electronic or test equipment, which require voltage without variation. *Voltage regulators* perform this task. They are best placed locally on the circuits requiring regulated voltage.

Many utility companies include in their rate schedule a power factor clause which may have one of two forms. Either a penalty is incurred for a poor

ELECTRICAL REQUIREMENTS FOR AN INDUSTRIAL BUILDING



POWER SUPPLY AND DISTRIBUTION

MAIN SUBSTATION

Notes: (1) protective devices should include lightning arresters, grounded fence, safety grounding mat.

(2) an access road should be provided for delivery and servicing of transformers.

Note: provide for power factor correction equipment

Note: provide throwover equipment for essential loads, spare transformer and cable.

PLANT PROTECTION

Security: Guard houses—telephone, electric heater, clock, remote gate control • Watch patrol system • Exit door alarm system Security lighting.

Fire Safety: Fire detection system • Fire alarm system • Fire pump • Sprinkler pump • Sprinkler Alarm.

Emergency Lighting:

MANUFACTURING

(Many machines of wide variety requiring a range of voltages, a-c and d-c, and even different frequencies of a-c)

ASSEMBLY

Electrical Distribution: Use industrial type underfloor duct or wireway • Provide flexible distribution; many small circuits.

Power Supply: 400 cycle current (special conversion and distribution) may be necessary for some equipment.

Lighting: High-level auxiliary lighting may be required.

INSPECTION

Power Supply: Regulated voltage for test equipment • 400 cycle current for some equipment.

Lighting: High-level illumination.

HEAT TREATING

Induction heaters • Infra-red heaters • Electric furnaces.

PAINTING

Spray booth compressors • Oven fans • Supply and exhaust fans Conveyors.

Note: observe code for hazardous locations.

WELDING

Correct for unbalanced current, pulsating current, low power factor.

RESEARCH AND TEST FACILITIES

Power Supply: Provide a range of voltages, a-c and d-c for flexibility—(1) Alternating current outlets, 120-v and 208-220-v, single phase and three phase; sometimes regulated voltage required • (2) Direct current outlets with range of voltages from rectifiers, batteries and motor generators • (3) 400 cycle generation and distribution.

Provide for heavy power consumption in—(1) Experiments (some conducted without interruption for long periods) • (2) Pilot plants.

Power Distribution: Explosion-proof wiring where necessary Local circuit breaker panels for short-circuit protection.

Equipment: Laboratories—Hood exhaust fans, heaters, water baths, drying cabinets, centrifuges, climatic chambers, electronic analyzers • Dark room equipment • Industrial X-ray machines Machine shop equipment.

Lighting: Provide (1) High-level, glare-free illumination for engineering department • (2) High intensity illumination for photographic studio.

MATERIALS HANDLING

Equipment: Hydraulic lifts for docks • Battery chargers for lift trucks • Conveyors • Cranes • Power-operated doors • Packaging machines.

Lighting: Lights for high storage bins • Lights for interiors of trucks or freight cars • Signal lights for lift trucks.
Note: Keep lights clear of overhead operating doors.

MAINTENANCE EQUIPMENT

Traveling scaffold for lighting fixture maintenance • Lighting fixture cleaning tanks • Transformer liquid cleaning equipment • Circuit breaker lift trucks • Power outlets for maintenance shop • Power outlets for vacuum cleaners.

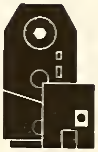
CHEMICAL WASTE TREATMENT

Pumps • Alarms • Recorders.

BOILER PLANT AND REFRIGERATION PLANT

Equipment: Supply and exhaust fans • Unit heaters • Hot and cold water pumps • Air compressors • High and low water alarm • Deep well pumps • Sump and Ejector pumps • Sewage treating equipment

Lighting: Overhead tank obstruction light.



COMMUNICATIONS

Public telephone system • Telephone booths • Intercom systems • Public address system • TV monitoring • Music distribution.

TIME SYSTEMS

Master clock and program control • Local clocks • Attendance recorders (provide time card racks) • Job recorders • Program bells and horns.

EMPLOYEE FACILITIES

Equipment: Vending machines • Water coolers • Power for cafeteria equipment.

Lighting: Parking area illumination.

power factor or a bonus is given for a good power factor.

What is power factor? How can it be improved? If, in the alternating current cycle, maximum voltage and maximum current occur at exactly the same moment, then the power factor is equal to unity or 100 per cent. This happens only when the load is non-inductive, such as with heating or with incandescent lighting. As soon as an inductive load is placed in the circuit, such as transformers, motors or fluorescent lighting, the power factor drops. This means that maximum current will lag behind maximum voltage.

The effect is that for the same amount of work to be performed, greater current is required at low power factor than at unity power factor. For instance, if at unity power factor 100 amperes were required, then at 50 per cent power factor 200 amperes would be required for the same amount of work. The size of conductors and all other components would have to be doubled, which is an obvious burden to both the utility company and the plant owner.

Power factor can be improved by capacitors and/or synchronous motors. *Capacitors* are devices placed in the line which, without actually performing work, tend to make current and voltage coincide. *Synchronous motors* are large constant speed motors which operate with a leading power factor, meaning that the current peak precedes voltage peak. If such a motor is placed on a system in which the opposite is the case, the tendency is again to bring current and voltage peaks together.

Unit Substations, Feeders

The various components described above, notably switchgear and transformers, are often combined in unit substations located at load concentrations throughout the plant. A *unit substation* — also frequently referred to as a *load center* — is a factory assembly of prefabricated, metal-enclosed, co-ordinated units. One simple type of unit substation is pictured here.

Feeders issuing from each of the several circuit breakers of the substation have specific assignments. Some supply production machinery, others the lighting system, still others the building utilities — but not directly.

The energy carried by the feeder is chanelled into still smaller circuits, the branch circuits. This is done in so-called panelboards, or panels, for short. Depending on the final use, panels either are lighting panels or power panels. The panels contain branch circuit breakers or branch fuses, each one sized accurately to protect the relatively small wires which supply the individual power or light outlets.

In large areas the circuit breakers of the lighting panels are also used to switch the lights on or off. The conduits from the substation to the panelboards are often carried overhead, attached to the structural steel. But modern plants more frequently utilize feeder conduits buried below the slab. This not only improves the appearance of the plant, but frequently reduces costs because the runs are shorter.

Since each panelboard is a tailor-made piece of equipment, and each connection from the panel to a machine is a permanent, laborious installation, this type of distribution is quite inflexible and therefore not well suited to the changing requirements of an active production area. Overhead busways are the answer in many cases for distribution to machines.

Busways are fabricated feeders available in several standard capacities in 10-ft lengths. These lengths are joined together to form the required run and are either suspended from the structure or supported on lally columns. Every 12 in. on the busway there is a plug-in opening into which may be connected a fused switch or circuit breaker to feed an individual machine. The flexibility of this system has made it the accepted standard of modern plants.

In assembly areas where row upon row of assembly benches occur, an industrial-type underfloor duct system is often advantageous. This type of underfloor duct is approximately 4 by 4 in. in cross-section, and care must be taken to thicken the slab under the runs.

Lighting

Lighting plays an important, though not always recognized, role in the efficiency of a plant. The purpose of the lighting system is to provide illumination on the work of such intensity as to facilitate the seeing task of the worker, and to minimize shadows, glare and — very important — reflection from shiny metal. A good lighting system will also contribute to a pleasant environment which in turn will aid morale.

Lighting intensity ranges from 10 to 300 ft-c or more depending on the severity and speed of the task. Here are a few typical examples:

Assembly, rough	20 ft-c
Assembly, fine	100
Assembly, extra-fine	300
Welding, general	30
Welding, supplementary	1000
Foundries	10–50
Steel fabrication	10
Storage and stock rooms	5–20

It is very often not possible for economic reasons or because of the shape of the equipment to provide recommended intensities by general lighting. In such cases, the less desirable alternatives of auxiliary local lights on the machines must be chosen.

Eyestrain can be reduced by keeping brightness contrasts low. This can be effectively aided by: (1) using open-top reflectors so that some light will go up to the ceiling, (2) keeping the floor in light colors, and (3) concealing the lamps by deep reflectors. Annoying reflections can be reduced by running fluorescent fixture rows in two directions to form a grid.

However, the above general statements cannot be applied everywhere due to the manifold seeing tasks involved in industry. For instance, some tasks are actually helped by the presence of shadows or reflections.

Lamp color is generally not of importance except where color itself is involved in the work, such as in textiles, printing, painting.

Each of the three major types of light sources — incandescent, fluorescent, mercury vapor — has a definite place in industry, depending on the type of work and height of area involved.

Large plants will find a scheduled lamp changing and fixture cleaning program economical. The oily atmosphere present in so many plants demands a more frequent cleaning schedule than other occupancies. It is also advisable to specify porcelain-enamelled reflecting surfaces in such areas, as baked-on finishes are more porous and tend to turn yellow faster.

Vibration-resistant lamp sockets or lamp holders are available and should be used in areas where vibration is pronounced. Heat, moisture, corrosive, dusty or explosive atmospheres — such conditions prevail in many plants or portions of plants. Careful planning can reduce ill effects on the electrical system.

Charles Payne

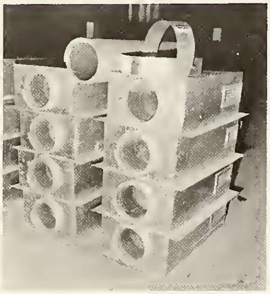
AIR COOLING FOR EQUIPMENT AND PEOPLE

Two duct systems satisfy widely different requirements in a telephone building, from normal office air conditioning to equipment cooling, which may change at a later date, with loads ranging from 10 even up to 140 watts per square foot

Most new buildings have air conditioning for people's comfort, and in this electrical age, more and more will have to provide air cooling for proper operation of communications equipment, electronic brains and similar apparatus. For example, heat given off by the equipment in the new Long Distance Switching Center in Wayne, Pa. for the American Telephone and Telegraph Company varies from 10 watts per sq ft to a staggering figure of over ten times that amount — 140 watts per sq ft — whereas in an average office building the total electrical load is only about 8 watts per sq ft. This newly completed, five-story building, designed by Lorimer and Rose, Architects and Engineers, is completely air conditioned: the first three floors are designed to accommodate the equipment and the top two are for office personnel. While such a large scale cooling problem as this might not be encountered too often, there are some ideas to be gained from the way the problem was handled here, where the emphasis was on flexibility, simplicity and ease of construction and appearance.

In this switching center, Richard P. Goemann developed for William A. Rose Associates, Consulting Engineers, a completely new modular, round duct system for the equipment floors, and designed an air radiant-convection system for the office floors.

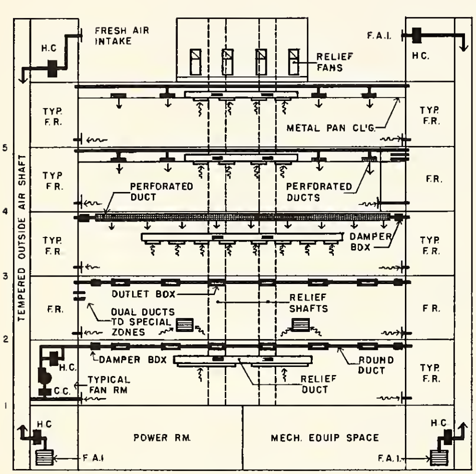
What were the physical requirements that made these systems logical solutions? Taking the equipment floors first, a cooling system was desired — for most of the area — that could handle cooling loads from 10 to 40 watts per sq ft, that would be flexible enough to handle a completely different cooling load pattern as equipment is added or changed without complicated and expensive



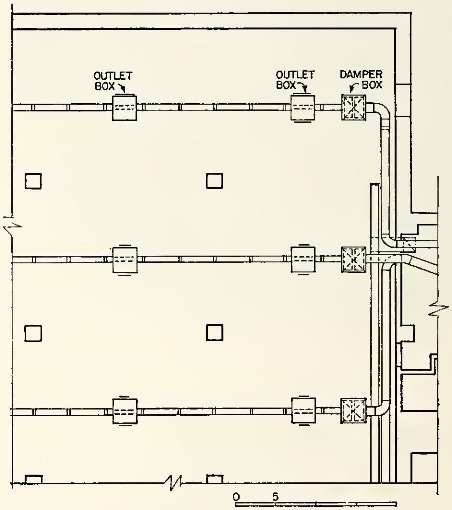
A duct, outlet boxes and strap

Metal gasket-straps are fastened to inserts in concrete slab

An outlet box is lifted into position



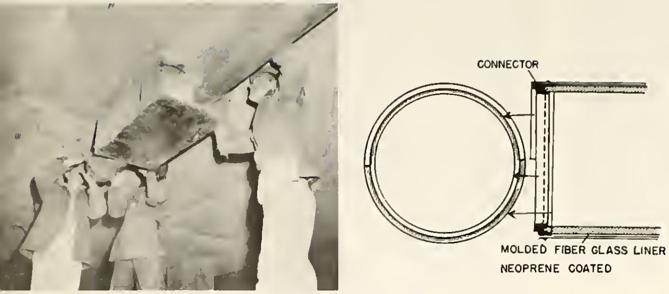
2nd & 3rd FL SYSTEMS COMBINE ROUND & FLAT PERF DUCTS



changes in ducts, that would have a duct network providing a neat appearance when left exposed, that could be fed from two separate cooling sources so that in case one failed temporarily, there still would be partial cooling provided by the other.

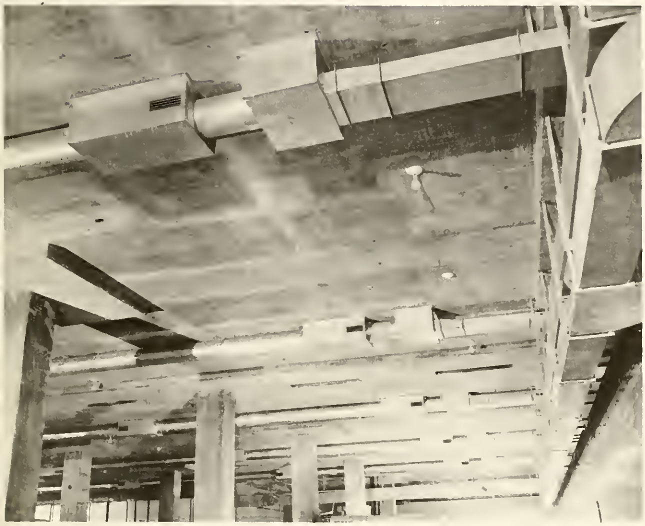
The system that was developed consists of a series of 11-in. o.d. round ducts, five sections per 22-ft, 3-in. bay, carrying air at a velocity of 3500 ft per minute. The air is fed from standard, rectangular ducts on two sides of the room first into primary pressure and volume reducing boxes, and from there into the round ducts which are connected to outlet boxes in each bay. Each outlet box supplies one bay, from two openings on opposite sides. Dampers within the box permit the two openings to be adjusted separately so that there might be, say, 350 cfm from one side and 100 cfm from the other. The ducts are sheet metal; covering ⅝-in. molded fibrous glass liners for acoustical and thermal insulation. They were given a smooth coat on the inside for treatment against the effects of high velocity air. One feature of the round duct is a reinforced plastic connector which provides an air tight seal and flush joints for minimum frictional resistance, and at the same time makes rapid installation possible (see detail). The ducts are tied to each other and suspended from the concrete floor slab above by means of metal strap gasket-hangars. No special duct construction is required on the job and the work can be handled by a two-man crew. At any time an outlet box can be dropped out or added because of the connector detail and strap hangar arrangement.

One important advantage of the round duct system is the possibility of having



Airtight fit is made between outlet box and duct by connectors and strap

Charles Payne Photos



a uniform size of duct throughout, for ease of assembly and clean-cut appearance, due to the wide range of control provided by the outlet boxes. (In fact, when used in other types of buildings, a hung ceiling would not be necessary.) Even at the end of a duct run there is still a greater volume of air available than there would be with gradually reduced-in-size rectangular ducts, designed this way so as to give uniform supply at each outlet.

In addition, by having a multiplicity of outlets over the floor area, draftless distribution is achieved.

The designer points out that the outlet box in this particular building should be considered a utility model, and that other shapes would be feasible if the system were to be used in commercial space.

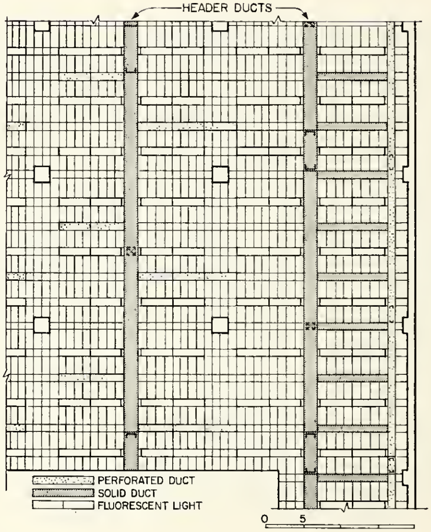
The first floor of the building is air conditioned completely by means of the round duct system. On the second and third floors there are some high-cooling load areas (140 w/sq ft) which are cooled by flat ducts, 24- and 26-in wide having perforated pans on the bottom. (On the second floor there is one 36- by 10-in. duct, the middle third of which has the perforated bottoms. On the third floor there are five 24- by 10-in. ducts 130-ft long with perforated pans the whole length.) Also there are some smaller rectangular ducts serving special areas. On the equipment floors, 100 per cent exhaust and fresh air can be employed at times during the winter to furnish all the cooling that is needed. Relief ducts at the front of equipment floors connected to a relief air shaft remove the waste air.

On the office floors a different approach was called for. Here in addition to comfort cooling there had to be a

METAL PAN SYSTEM

Charles Payne

Air for conditioning office areas is distributed through header ducts with solid metal pan bottoms to branch ducts with perforated pans, admitting air to the room. In high load areas, long ducts (below) either 24- or 36-in. wide, and with perforated pans handle loads up to 140 w/sq ft



fairly high level, but glare-free, lighting system and sound-absorbent acoustical treatment. All of these features could be integrated in a metal pan ceiling by using strips of perforated panels either for air diffusion or backed by batt insulation for sound absorption, and with spaces left for recessed fluorescent fixtures having parabolic shaped reflectors. Here's the way it works: Solid-bottom metal pans topped by inverted "U" shaped covers form headers which supply other branch ceiling ducts which have perforated bottom panels. They have various lengths and frequency of repetition in the ceiling, depending on the particular cooling load.

Advantages of this ceiling system include the following:

1. The ducts form part of the ceiling, either with solid or perforated bottom.
2. Various degrees of cooling load can be handled merely by providing more panels in the form of ducts.
3. The ceiling appearance is not affected in the slightest when more duct area is needed.
4. Some panel heating and cooling effect is experienced, providing a greater sense of comfort.
5. Perforated panels can be interchanged with solid panels, allowing a wide range of flexibility in air distribution.
6. The panels may be removed easily for service.

Even where there may be small areas with high cooling load, this can be handled by substituting a ceiling register for a perforated panel.

The metal ceiling system had its first large application in the A. T. & T. Long Lines Switching Center in White Plains, N. Y. also designed by Lorimer and Rose.

DESIGNING WITH FLUORESCENT LIGHTING

By Dr. Matthew Luckiesh

Everywhere in the world of industry the taste, understanding and ingenuity of the architect are needed if the relatively unlimited possibilities of fluorescent lighting are to be adequately practicalized.

In the past decades of filament lighting, the ability of the architect was challenged only by the occasional interior. For the most part his problems in artificial lighting were confined largely to providing the wiring and outlets and to the selection of ready-made lighting fixtures. There were relatively few opportunities for ingenuity and creative ability, particularly in the work-world. But the advent of fluorescent lamps has opened a new era.

Artificial lighting is no longer confined to hanging individual fixtures on ceiling outlets. Structural details in new buildings can be the "fixtures." The architect can make structural forms serve the additional function of reflectors or luminous areas. In offices, drafting rooms and elsewhere, desirable impressions of extent, expanse, order, neatness and smoothness can be realized by lines, areas and patterns of light flush with the ceiling. Even in old industrial interiors the architect can lead troughs of light continuously in lines, curving around corners or combining in patterns, symmetrical and consistent with the work-spaces and with the interior structure.

Fluorescent Lamps Provide Impetus

The influence of a science of lighting, which has been evolving from the science of seeing, was already evident when filament lamps were still the dominant light-sources. However, with the advent of fluorescent lamps, the floodgates of opportunity were opened wide. The new luminous era became an extensive and practical reality. The luminous efficiency of these new sources was initially more than twice that of filament lamps. They provided relatively *cool* footcandles. The amount of energy accompanying each footcandle is only about one-fourth that accompanying each footcandle provided by filament lamps. Fluorescent light upon the work and worker is comparable in coolness with natural light. For the first time in the course of light production, efficient and effective control of the color of artificial light became possible. World War II interrupted developments, but it can be safely predicted that in all these respects further progress is in the offing.

Filament lamps are not bowing off the stage. Their relatively small and brilliant light-sources make possible the optical control of light for a variety of purposes. However, fluorescent lamps with their relatively low brightnesses, large light-sources, coolness of light, and color quality which blends with daylight, will dominate the work-world. They provide opportunities for ingenious structural lighting, desirable area lighting, and satisfactory space lighting which provide adequate light for critical seeing over long periods.

Good Seeing Conditions

Seeing is a very complex matter which not only involves the task to be performed and the relationships of light and sight. It involves brightness not only of the task but also of the immediate and general surroundings. Furthermore, the seeing conditions should be such that not only is seeing easy and comfortable at the moment, but over long periods of prolonged critical seeing. Here the major principles are merely stated but they are discussed in connection with illustrations selected for the purpose.

The dividends from better seeing conditions are paid not only in increased production and safety and in decreased waste of time and materials. Such benefits are more or less obvious and immediate. Less apparent, but of even greater importance, is the waste of human resources, such as eyesight and energy, as the days and years pass. The efficiency of a worker is not measured merely by the useful work he does per hour or per dollar. It is properly measured in terms of his expenditure of his own human resources. He is most efficient as a human seeing-machine when the waste of his resources is reduced to a minimum. Better lighting for easier seeing not only influences production, spoilage and safety today; its contributions to the conservation of human resources, to human welfare and to human progress extend far into the endless procession of tomorrow.

The objectives of lighting and seeing conditions can be simply stated if not easily attained:

1. Maximum visibility of the object to be seen or of the visual task to be performed.
2. Maximum comfort of the observer (worker) at all times and, more broadly, maximum ease of seeing when critical seeing is being done.

The term, comfort, is here used in an extended sense. It means more than the absence of obvious discomfort, for it includes effects of seeing which cannot be appraised introspectively but which combine to produce some degree of ease of seeing.

The minimum requirements that should be fulfilled by a lighting installation are briefly:

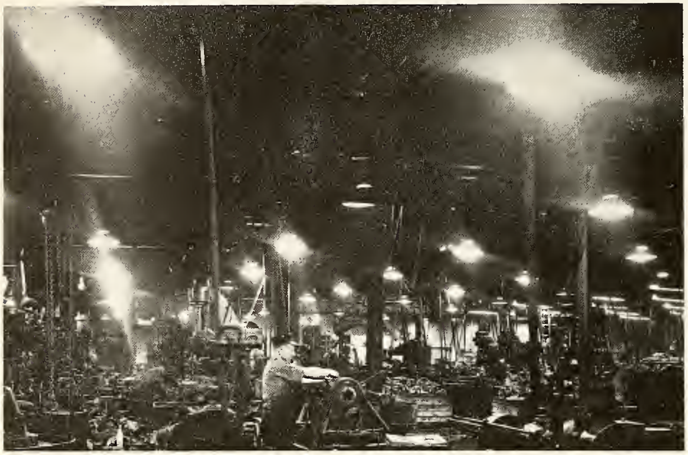
1. There must be a sufficient quantity of light (footcandles) on the object to be seen or on the task to be performed.
2. The light must be applied so that the distribution of brightness in the visual field does not cause unnecessary annoyance or discomfort. This involves the elimination of preventable glare from light-sources and the proper reflection-factors of surfaces obtained by paint or other finishes.

Reduced to its fundamentals, comfortable lighting and good seeing conditions depend chiefly upon three factors which should be borne in mind in studying any work-world environment. They are briefly:

1. *Footcandles on the seeing task*. The requirements in this respect vary enormously for various work-world tasks.
2. *Footcandles at the eyes of the worker*. These should be limited to a fraction of that on the work. Too much light on the eyes compared with that on the work definitely means unnecessary glare. The results are decreased visibility and increased annoyance and discomfort.
3. *Brightness of light-sources (or areas) and brightness-ratios in the visual field.*

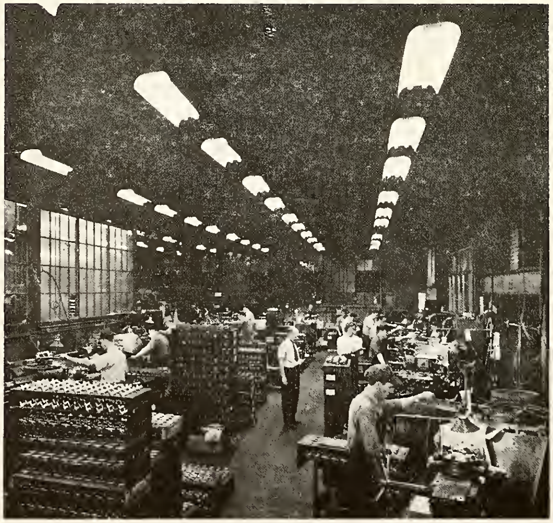
1. Fig. 1 illustrates a very common defect of lighting installations in industrial places. The bright fixtures are seen against the dark background above. This background is dark for two reasons. Little light reaches it directly, and the reflection-factor is low. The ceiling, and generally the upper walls, should be painted white, and an appreciable amount of light should be permitted to escape upward. The resulting luminous background greatly decreases the brightness-ratio between the bright fixtures and their immediate surroundings, reducing the glare from fixtures in the visual field of the worker.

The sky outdoors greatly mitigates the glare of the sun, and it contributes light to the shadows. Of course the sun is too bright to be viewed with comfort, but on a hazy day the analogy is fairly satisfactory Good lighting and seeing conditions indoors are produced by the equivalent of a luminous sky. Light and white paint (or its equivalent) on the ceiling are generally essential for comfortable seeing indoors.



1. *Illustrating some common defects of lighting: spottiness, shadows, dark ceilings and high contrast-ratios between fixtures and their background*

2. Although high brightness-ratios between lighting fixtures and the ceiling are more common defects in filament lighting, the same shortcoming is found among fluorescent lighting installations. Fig. 2 illustrates some improvement over Fig. 1 by supplying more footcandles at the work from sources of fairly low brightness. There is also an advantage of less harsh shadows due to the more extended light sources and fixtures. However, the ceiling is dark, with the result that the brightness-ratio between the fixtures and their background is too great for ideal seeing conditions. If a worker must be in such a position that the length of the room is in his field of view, and if he is looking in a horizontal direction, the footcandles at his eyes would be a rather large fraction of the footcandles on his work. This would indicate too much preventable glare. Plenty of light on the work and not too much light on the eye is a simple statement of an objective which is not always easy to attain. However, it must be attained if seeing conditions are to be satisfactory.

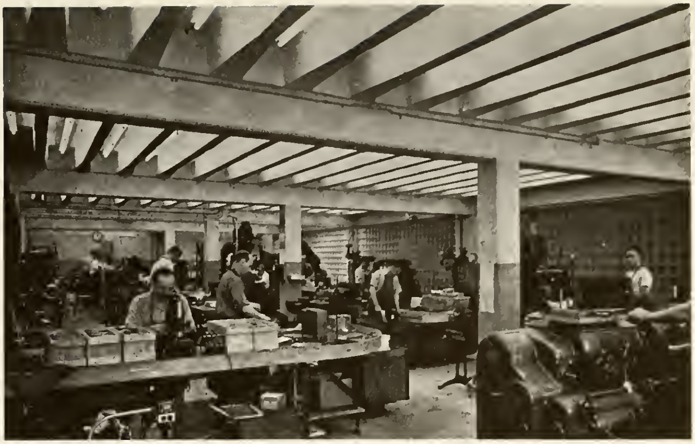


2. *This is some better, but there is still too much contrast with the dark ceiling, even though flourescent lamps are not as "bright" as filament lamps*

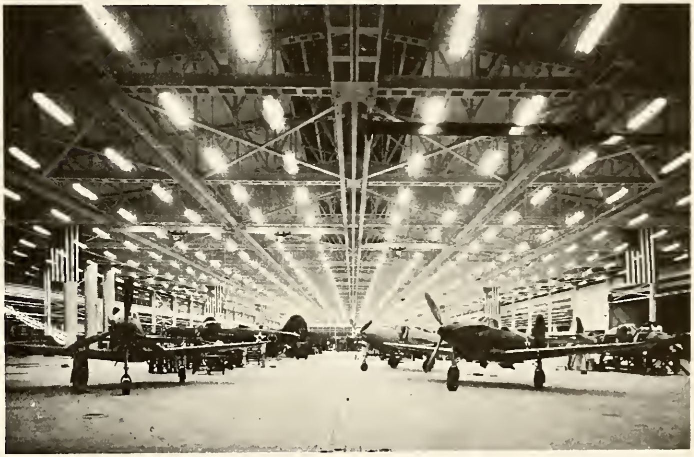
3. Naturally, with the advent of fluorescent lamps, lighting fixtures were adapted to utilize them. However, as the lighting industry began to sense the extended possibilities of these long light sources of low brightness, the old fixture traditions began to give way. An example of an installation of fluorescent lamps without fixtures is illustrated in Fig. 3. Advantage was taken of the structural forms in the ceiling. These were not specially designed to be ideal for the purpose, but they illustrate the possibilities that are within the control of the architect. The resulting illumination on the theoretical horizontal work-plane was 85 footcandles after 1000 hours of operation.

This level of illumination is readily obtained with fairly satisfactory seeing conditions. A worker looking in a horizontal direction perpendicular to the ceiling beams is not confronted with bare lamps in most of his visual field. The lamps are screened from his eyes by the beams. The sides of the beams are painted white so that the ceiling appears to be an expanse of brightness intercepted at close intervals by the darker bands. This installation suggests what an architect might accomplish by designing the ceiling members so as to perform their major purpose as supports and still be ideal in form for the most efficient utilization of light. The sides of the recesses might be inclined more from the vertical or might be curved. The cross-section could be parabolic so that the light might be directed more generally downward. This would result in less light lost by multiple reflections in the recesses themselves.

If the sides of the recesses were properly sloped or curved, there is some advantage in using aluminum paint. Its characteristics are such that the apparent brightness of the sides could be reduced if desirable and still efficiently reflect the light generally downward.



3. *Structural elements serving as lighting fixtures illustrate design possibilities. (Installation at W. M. Welch Manufacturing Co., Chicago)*



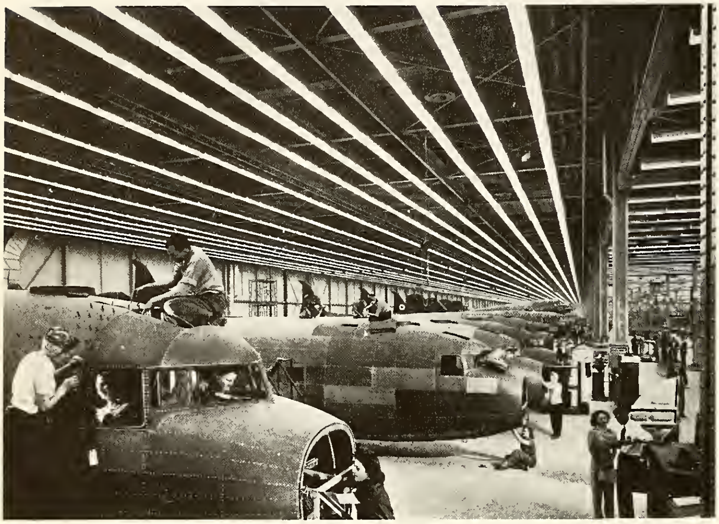
4. *In a large interior, with high ceilings, the fixtures should be hung as high as possible. (Bell Aircraft plant, designed by the Austin Company)*

4. In large interiors with very high ceilings many individual fixtures contribute light to a given work place near or at the floor level. The effect approaches, in some major respects, the lighting effect of a large expanse of uniformly bright ceiling. This is illustrated in Fig. 4. The floor is of concrete with a relatively high reflection-factor. This so-called white concrete is an excellent feature which contributes favorably to lighting and seeing conditions. The floor reflects some light to the ceiling and upper structure, which are properly painted white. This reduces the brightness-ratio between the fixtures and their background. These brightness-ratios are still too high to be ideal. Some lamps might well be installed so as to send their light to the upper regions. The reduction of these brightness-ratios is an important objective toward the realization of the over-all objective of comfortable seeing.

In a large interior such as illustrated in Fig. 4, the fixtures can be hung high without seriously reducing the efficiency of utilization of light. Actually, if a work-area is very large, the fixtures can be hung very high without any appreciable loss of light. This is a simple fact which is easily proved; it is surprising that so many persons believe that light is wasted in such interiors if the fixtures are hung high. Hung high, fewer of them are in the visual field of the worker. This reduces the foot-candles at his eyes, which is a partial measure of glare.

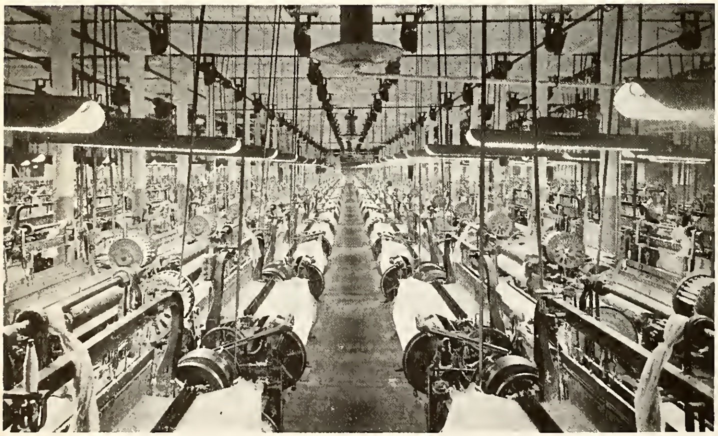
5. In Fig. 5 is illustrated a low-ceiling section of a windowless aircraft plant of enormous area. Here individual two-lamp fixtures were installed in continuous strips, with a sufficient number of rows to provide 55 footcandles throughout the horizontal work area. The floor is of so called white cement, which reflects a good deal of light upward, thus promoting both visibility and comfortable seeing. The result on the upper and vertical surfaces of the aircraft is a fairly "shadowless" illumination.

The result can best be appraised by recalling how satisfactory the lighting is outdoors in the shade of a building. The annoyance of shadows is reduced to a minimum and many work surfaces, regardless of their orientation, are well lighted. Of course, portable lighting units are necessary for critical seeing in the interior of the aircraft. The lighting and seeing conditions approach that of a natural skylight without the annoyance due to powerful sunlight in the latter case. Incidentally, the reflectors were made of pressed wood which was bent to a proper shape and coated with a synthetic white enamel. This illustrates another departure from the traditional use of metal reflectors. Architects may well bear this in mind in designing strips, areas, troughs and coffers to fit the location and routing of work.



5. *Close-spaced continuous strips of light in a low-ceiling area provide "shadowless" lighting approaching a skylight effect. (The Austin Company)*

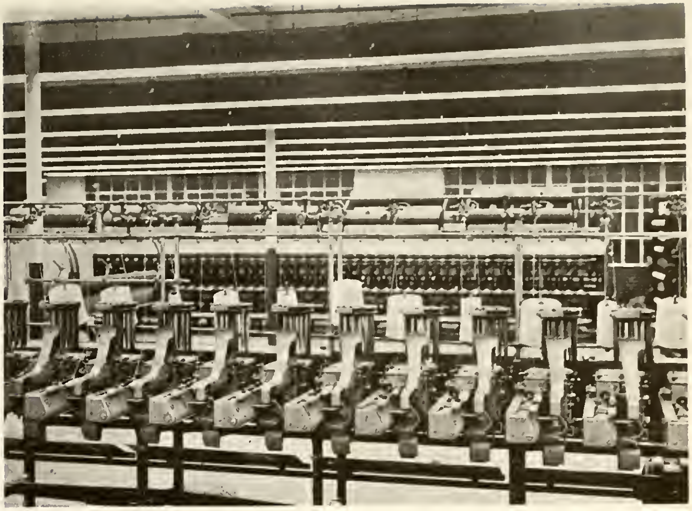
Hedrich-Blessing Studios



6. *Acres of intricate machine parts and threads in this textile mill can be seen easily; ceiling lighted by reflection. (Mills Mill Co., Greenville, S. C.)*

6. Textile mills well represent the extreme condition where critical seeing must be done everywhere throughout acres of intricate machines. The results illustrated in Fig. 6 are a far cry from the seeing conditions in many mills with the spotty and shadowy lighting due to poor spacing of filament lamps. This is one of the first installations of the fluorescent-lamp era in textile mills. The fixtures were spaced at 8-ft. intervals and hung from the ceiling as shown. They supplied 40 footcandles to the critical work-areas. With the ceiling painted white, it is far from dark, due to the light reflected upward from the white textiles. However, eventually it will be recognized that, in such places where the ceiling can be maintained with white paint, it is not a waste of light to emit some light from the lamps directly upward. This reduces the brightness ratio between the fixtures and their background as seen by the workers, which results in increased visibility of the work and in more comfortable lighting.

7. Continuous strips of fluorescent light are illustrated in Fig. 7. The room is 152 ft. long and 50 ft. wide. There are 25 rows of metal troffers, each consisting of 12 4-ft. sections and each section containing a 40-watt, 48-in. fluorescent lamp. The level of illumination from the skein to the rack is 35 to 40 footcandles. By installing two lamps in each section, 75 footcandles are readily obtained. Here again it is seen that in designing such a structure it may be easy to provide places for continuous strips of artificial lighting. The installation as illustrated in Fig. 7 represents a great step away from spotty shadowy lighting of the dark era of not long ago. However, higher levels of illumination are still desirable and preventable glare can be still further reduced. It appears unnecessary to emphasize that the greatly improved seeing conditions inevitably pay large dividends in decreasing spoilage and waste of time. Furthermore, favorable effects upon the attitude, morale, safety, eyesight and expenditure of energy of the workers are inevitable. Workers *are* human beings and as such they cannot escape the favorable effects of favorable seeing conditions.

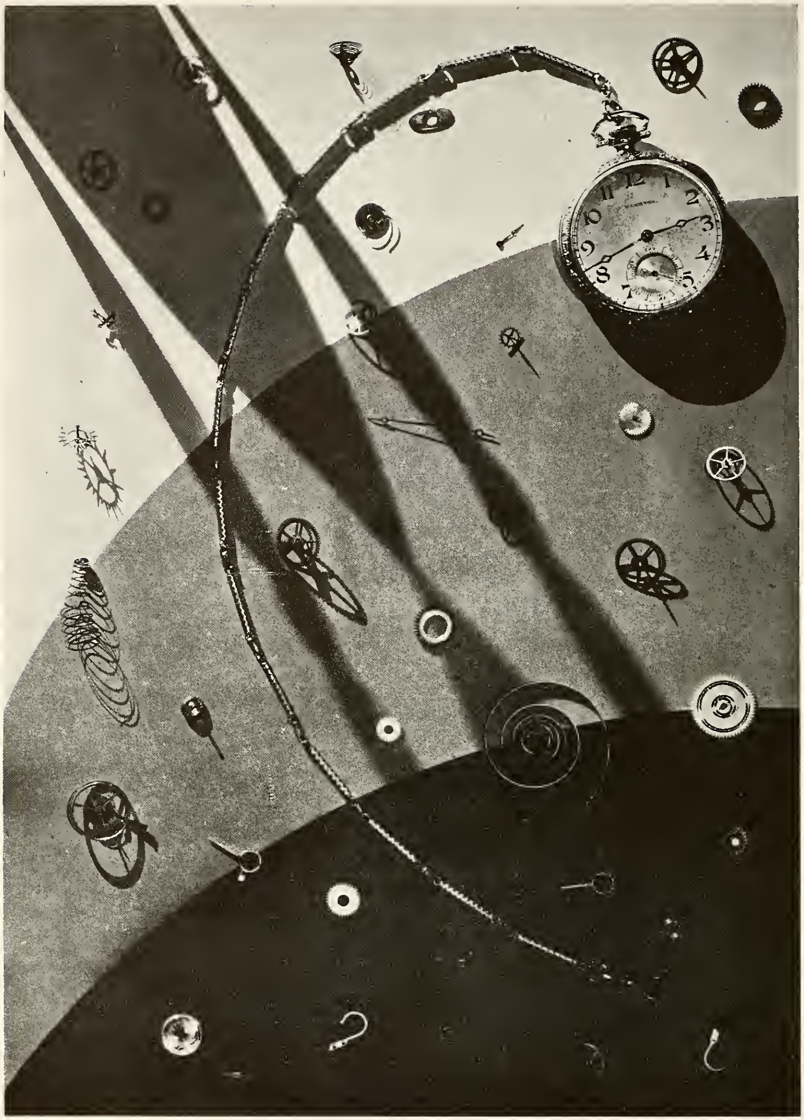


7. *This "great step toward daylighting" makes countless details fairly visible from most directions. (Installed at Uxbridge Worsted Co., Uxbridge, Mass.)*

8. *From the standpoint of seeing details regardless of their orientation, this lighting approaches that of outdoors in the shade. (Uxbridge Worsted Co.)*

8. A close-up of frame spinning is illustrated in Fig. 8. The rows of luminous troffers were spaced 6 ft. apart and in each row there were two continuous lines of 40-watt, 48-in. fluorescent lamps. The illumination at the upper rolls is 57 footcandles and at the lower rolls is 40 footcandles. On the vertical plane of the machine there were about 30 footcandles.

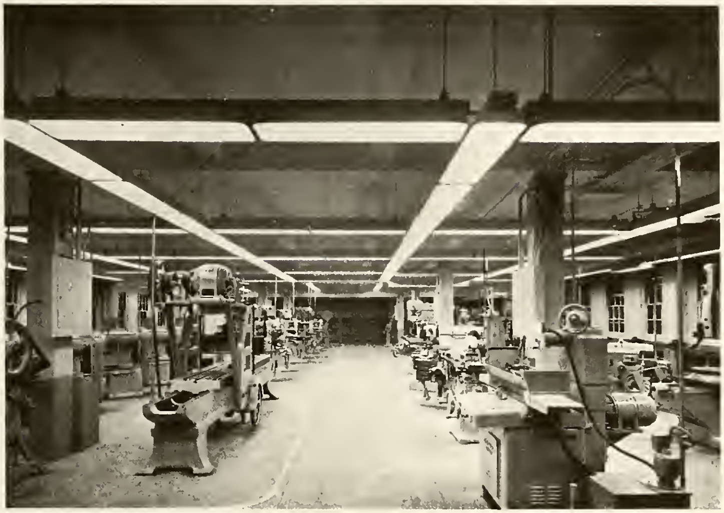
Although these levels of illumination are far less than outdoors in the shade, the lighting from the viewpoint of being able to see the various details regardless of their orientation is reminiscent of skylight outdoors in the shade. Imagine the ceiling of this interior to be tilted on one edge until it is vertical, leaving these intricate machines and processes exposed only to the outdoor skylight. It does not tax the imagination to visualize how easily all the moving threads and all the intricate parts of these machines could be readily seen outdoors.



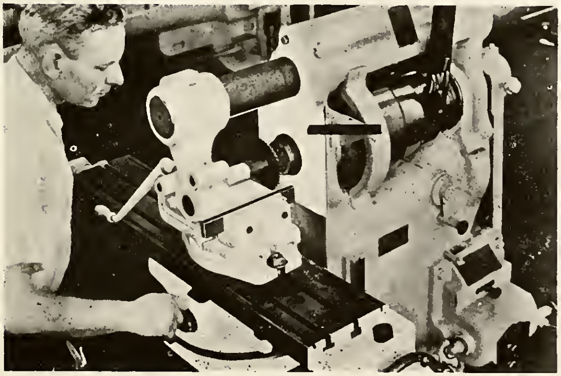
Any visual task involves four fundamental factors of visibility: (1) the size *of the details to be seen; (2) the* brightness-contrast *between the objects and their background; (3)* brightness *of the objects, which varies with footcandle level; (4)* time *required to see. From "Light, Vision and Seeing," by Matthew Luckiesh, D. Van Nostrand Co., N. Y.*

9. In Fig. 9 is illustrated an advanced example of the use of fixtures in continuous strips and the proper use of paint as a powerful ally to lighting and seeing. With continuous luminous strips in two directions at right angles to each other, the elimination of annoying, harsh shadows is fairly well achieved by a general-lighting system. A large luminous area such as a skylight or the ceiling of an indirectly lighted room sends light to the work from many directions. This greatly reduces the shadows cast by the worker or by parts of the machinery upon the critical visual task. Where luminous strips are widely separated as in Fig. 9, the additional strips at right angles are helpful in reducing undersirable shadows. The illumination on the horizontal work-plane is 85 footcandles.

In this case paints of proper reflection-factors are used on ceiling, walls and machinery. It has long been known that by painting appropriate areas of machines with white or other highly reflecting paint, seeing of the critical tasks and parts of machines is improved. This is due in part to the reflection of light by these areas and partly to the bright backgrounds against which the critical detail of the task is silhouetted.



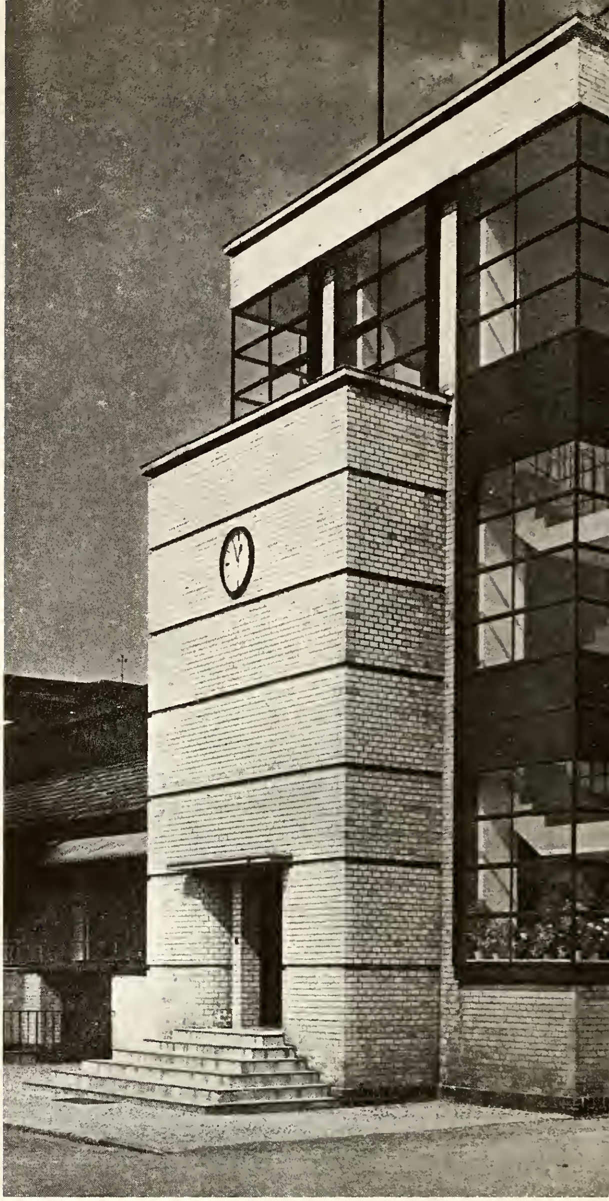
9. *An excellent example of the use of light and paint to reduce harsh shadows. Criss-cross arrangement helps to minimize glare. (New York Trade School)*



10. *Better seeing, better safety, from painting machine parts white*

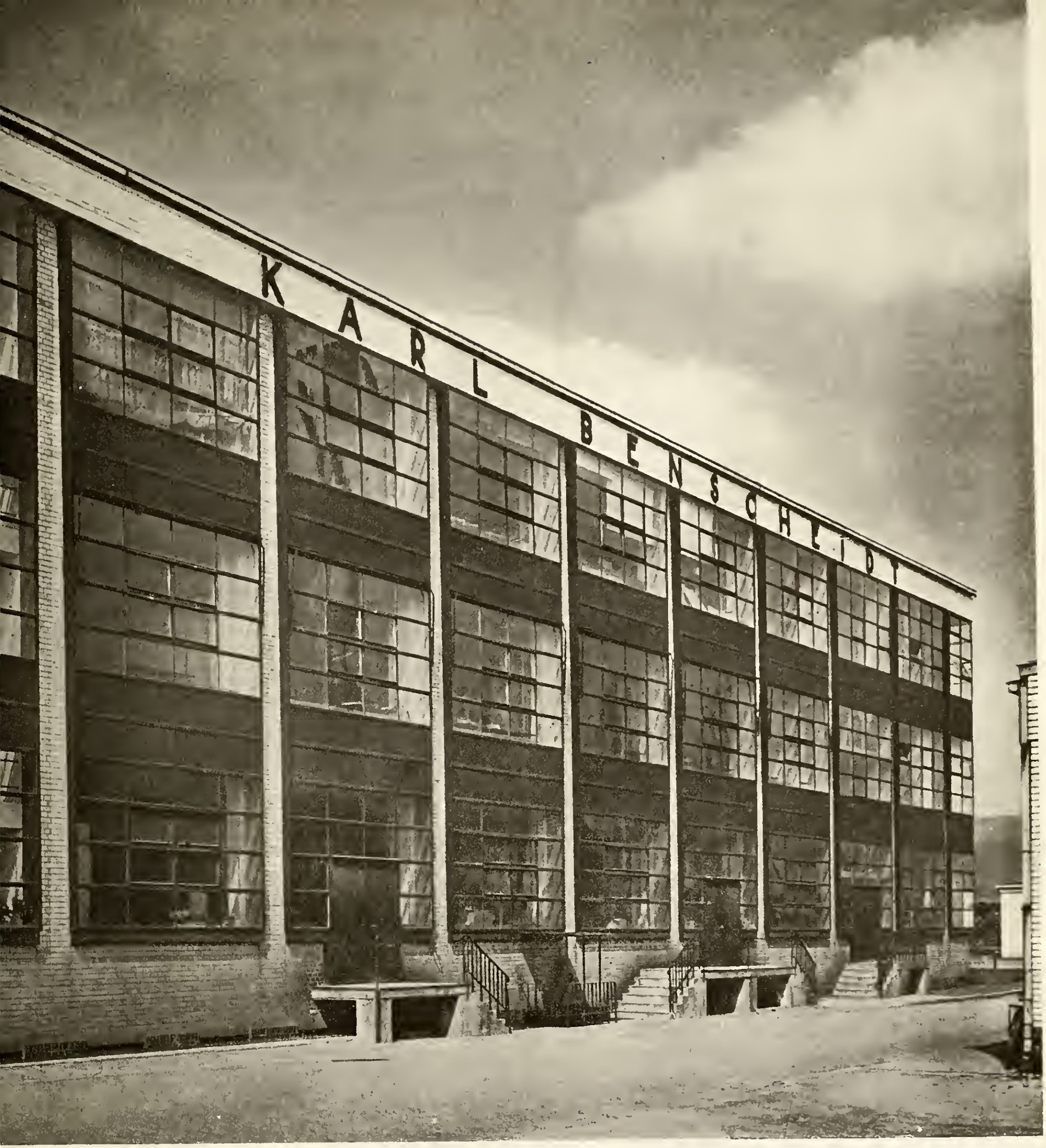
10. In Fig. 10, a close-up of a machine, with certain parts painted white, suggests something of the contribution made to visibility and easier seeing which results in better work and increased safety. Colored paint has some possibilities from a safety viewpoint, but one should avoid the confusion of too many colors. The use of color should be restrained and should be based on careful study of each case. Brightness is the major factor in seeing, but color can be used to delineate dangerous parts of machines. The color should have a fairly high reflection-factor in order not to lose the brightness-contrast advantage.

THE KARL BENSCHEIDT shoe last factory on the right has been selected by Walter Gropius, the pioneer architect and educator, as one of the especially significant buildings of his outstanding career.



1911-12

WALTER GROPIUS



1911–12 Shoe Last Factory, Karl Benscheidt, Alfeld, A. L. Built 1911–12, photographed 1954. Walter Gropius with Adolf Meyer

WAREHOUSING

By William H. Meserole, President
*Ballinger-Meserole Company**

Food Distribution Center for Penn Fruit Co., Inc.
Philadelphia, Pa.

The Ballinger Company, Architects and Engineers

Skyphotos

THE FIRST MODERN one-story "streamliner" food distribution depots were built in the early 1930's. They had 14 ft. ceilings. Their operators put cubage to use and handled tonnage on skids and high-lift platform trucks. What was then called the assembly line was in use, though still controversial.

Plenty was wrong with these warehouses, by today's standards. But considering they represented the first admirable steps toward high tonnage output per man-hour, they were meaningful.

They were radical, too. They departed from the multi-story concept that had dominated distribution warehouse history since days of yore when transportation was primitive, when distributors were obliged to locate near the market place and build level on level to justify real estate costs. Waterfronts were good locations because the upper floors of buildings could be loaded by ships' gear and unloaded by chutes. Hydraulic, then steam, finally electric elevators were introduced, and for generations it seemed as though invention to make these buildings ever optimum would keep abreast of need.

The first fork lift truck, circa 1916, developing slowly through the Twenties, found the chinks in the giants' armor and in the mid-Thirties tumbled them to the

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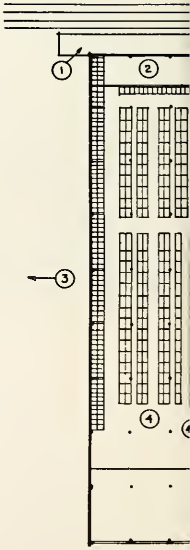
**The Ballinger-Meserole Company has organized operations and space for some 300 warehouses in the past decade.*

1. **Truck dock, cigarettes**
2. **Cig. warehouse & stamping**
3. **Expansion area**
4. **Premiums, shelf goods, etc.**
5. **Fast-mover stacks**
6. **Reception & shipping platform**
7. **Truck dock**
8. **Detail. End elev. of fast stacks**
9. **Storage stacks, turnover lots**
10. **Storage stacks, long buys and balloon goods**
11. **Incinerator**
12. **Baler**
13. **Type & size of pallet**
14. **Pallet racks, med. fast movers**
16. **End elev. of pallet racks**
16. **Double rail spur, 32 cars**
17. **Rail rec. platform**
18. **Truck rec. & ship. platform**
19. **Truck dock**
20. **Charger benches**
21. **Racks for very slow movers**
22. **Tow-line, set in floor**
23. **Charger benches**
24. **Banana, tomato, melon rooms**
25. **Toilets, lockers, overhead**
26. **Produce floor**
27. **Warehouse offices**
28. **Self-adjusting dock boards**
29. **Fish cooler**
30. **Fish freezer**
31. **Frozen foods**
32. **Meat rail**
33. **Boxed meats**
34. **Meat & fish truck dock**
35. **Cheese cooler & work**
36. **Meat cooler**
37. **Wet produce cooler**
38. **Dry produce cooler**
39. **Compressors**
40. **Office**
41. **Meat office**
42. **Employees entrance**
43. **Corridor to office**
44. **Start of order-pick**
45. **End of order-pick**



ground. Wage rates had risen under NRA and the New Deal and goods no longer could be handled piece by piece in quantities per man-hour justifying the higher wage rate.

Elevators became serious bottlenecks; nine-foot ceilings then common forced operators to spread out the goods and increased distances traveled at more and more cents per man-hour. So, few if any multi-story distributor warehouses have been built since. The trend has been strongly toward "streamliners," with effort concentrated on improving operations within them.

This was all part of the drive to justify the rising wage rate. Labor cost as a percentage of sales has not declined since the Thirties, but the ratio has not increased either. Concurrently, the dollar wage rate has rocketed to three or four hundred per cent of what it was. Real wages have increased substantially since the value of goods has not risen that much.

Continual improvement of materials-handling devices — mechanical and procedural — arrested the percentages. We have machines today that run faster, lift more goods higher and require less waste space for aisles than ever before. The procedural improvements followed recognition of certain low-cost-causing principles that are so obvious they should have been detected long ago.

"Right" mechanics and structures, for distributors' purposes, have joined with the burgeoning population to make this the century of scientific distribution at the middleman level.

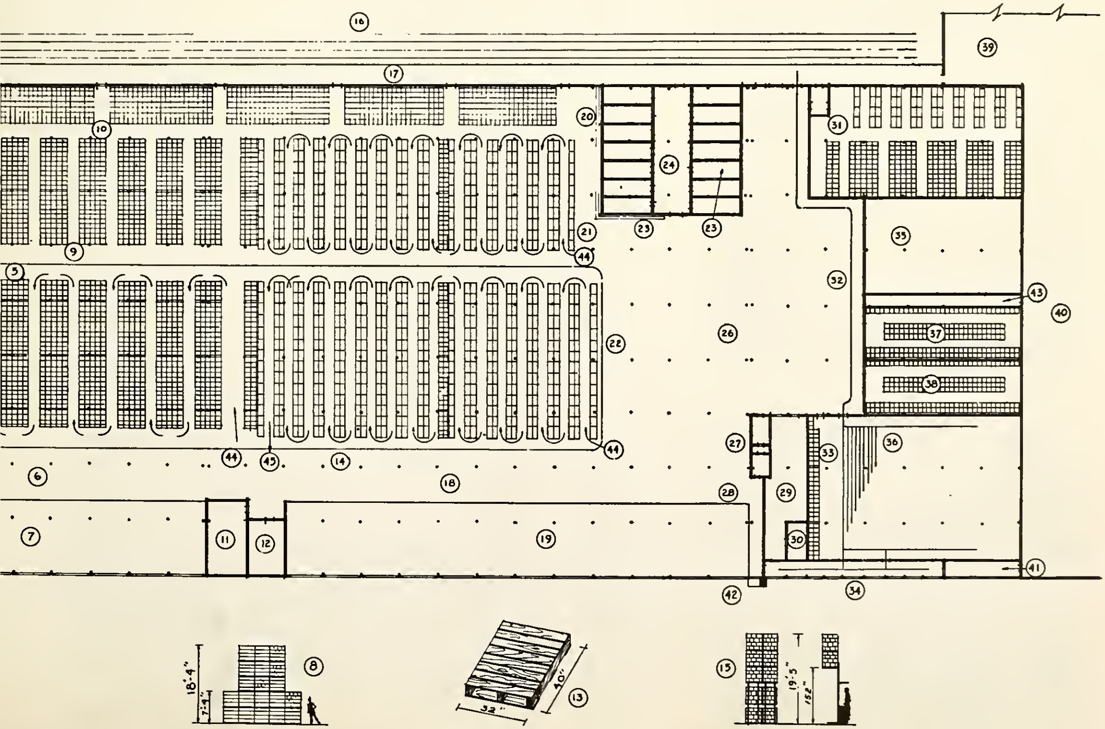
What is the architect's place in this picture?

Too often clients "guesstimate" they need a new plant a certain per cent larger than what they have. Too often the architect has no way of checking the estimate. So he accepts it, assuming the client knows how much space he needs, and away we go.

Common mistakes found in warehouses are:

- too small or too large in footage
- too low in ceiling height
- badly column-spaced for usage (however economical)
- wind bracing impeding usefulness
- badly proportioned
- ill-shaped, as in a "U" or "L"
- improperly slab-heighted for trucks and rail cars
- on inadequate land prohibiting expansion
- too expensive
- badly floored as to surface, thickness, joints and just plain quality

Clients' estimates and architects' assumptions are often wrong. The architect should recognize the client as a merchant who, incidentally and unwillingly, must maintain a warehouse he views with distaste because its operations are far less flexible than his genius as a merchant. He is not a specialist in physical operations. He is impatient with his warehouse superintendent who is, or should be, a specialist.



Let's face it: not all are. Many, emerging from the labor force, learn all they know within the four walls of one warehouse and acquire reverence for its customs. They lack the perspective they could have, had they been exposed to other methods and mechanics in other plants.

Operations Planning

Intelligent distributors have recognized their own inability to design either their own physical operations or their own plants for lowest-cost operations. Many have sought help from a new species of specialist — the operations consultant — who has sprung up in response to demand.

Materials and dimensions, important though they are, depend heavily on several significant principles of inventory and work organization.

One can be stated simply: *labor cost rises dollarwise with distance and tonnage.* To apply this, up-to-date general-line food warehouses are organized on a ton mileage basis (as shown in the diagrams). The time-honored likeness grouping of goods — flour here, canned vegetables there, canned fruits somewhere else — no longer is maintained. The new concept of departmentization is built on such factors as fast and slow movers, shelf stocks, etc.

By these means the inventory is organized to minimize walking and hauling. Daily tonnage is moved in and out of the warehouse with fewest steps, turns of wheel and man-hours. The shape and proportions of the warehouse can enhance the results of these achievements.

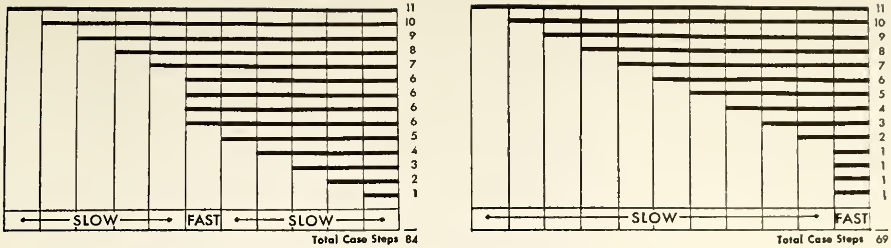
Proportion of Buildings

Architects know that square buildings are cheaper because the perimeter is shorter and less wall is needed for a given footage and cubage. But more important than any saving in building cost is the lower cost of labor when the warehouse is well proportioned.

Walks and hauls are greater as the ratio of length to width of the structure increases. For reasons of labor cost we believe it unwise for proportions to exceed three to one in a dry grocery distributive operation. As that ratio is exceeded it becomes harder to organize the warehouse for labor economy because the increase in length of walks and hauls is proportionate. Travel takes time. Time is bought by the man-hour.

Of course contiguous and related though separate functions can be set up in warehouses of any L-W ratio so long as no unified function occupies space exceeding the three to one proportion. A produce department may be set up at one end of a warehouse; a grocery operation at the other. Neither need occupy space ratioed over three to one, though total space may be five to one.

Odd shapes like the "U" and "L" should be avoided. These are hard to organize for economy and require more wall to enclose a given footage or cubage. Too narrow a site, selected because of excellent location, should be avoided — at least for grocery warehouse purposes. Plots less than 300 feet wide in the narrow



The Ton-Mileage Principle — How the strategic placement of one fast-mover item reduces the case-steps

axis between a highway and a rail line may set up unexpected difficulties, like this:

truck dock	100 ft
covered truck dock	50 ft
inside shipping platform	25 ft
rail siding and platform	32 ft
	207 ft
left for stacks and aisles	93 ft
	300 ft

Under conditions like this, operations within a 40,000 sq ft warehouse (a small one) will be conducted in space ratioed at more than four to one. That ratio will increase, dragging rising labor cost with it, as any building expansion is made, since the warehouse can expand only laterally.

You can "correct" by making other mistakes, like minimizing the truck apron and eliminating the rail platform. Still the lateral expansion of the building is so limited by the three-to-one rule that the user will be driven out of his new warehouse by rising labor cost as his business grows.

How Much Land?

Another good generalization is that the future should be anticipated by securing enough land. The plot can well be big enough so not more than 25 per cent will be covered by the initial construction. The growth of food distributors is limited usually not by the market, but by their physical facilities. With labor cost lowered through a well-designed operation in a good new warehouse, growth and need for more space is likely to occur very soon. There must be a place for it.

Expansions should not be built until they are really needed. Gross margins being low in the food industry, few can pay 1960's occupancy cost out of 1955's dollar margins and still stay in the black. The question then is: how much warehouse does the client need right now?

We have conventions that work well for us in basic planning to determine warehouse size. The following illustration is based on use of the 40 by 32 in. pallet; 20 ft clear inside heights; standard dry grocery inventories; use of straddle-type high lifts, and reasonably-sizeable operations.

Here is the formula we use;

Dollar inventory divided by $5 as the average case value yields number of cases in inventory.

Divide the number of cases by three, since three pieces per square foot can be stacked — yield is stack and aisle space required.

Add 20 to 25 per cent for non-inventory footage needed to get total footage required to carry the inventory at 70 per cent of "shoehorn" capacity, including non-inventory space.

From this, the building can be sketched, layouts made, and operating load computed. As a rule, minor addition or subtraction of space for more or less office, cooler or shelf department will portray accurately the client's space needs.

For a general-line dry grocery distributor, about 30,000 square feet is the low limit of size. For the operator who would use such a building the inventory load, which we've seen how to compute, is not the criterion of size. Rather, the criterion is spread of inventory — the variety offered for sale. The total number of cases, regardless of variety, is another matter. That governs the size of the building needed by large distributors.

It has been our experience in warehouses as small as 30,000 square feet that the inventory capacity is ample when there is aisle space enough to set up the spread. In such a warehouse 2500 items can be carried, and over $4 million in annual volume accomplished. At 100,000 square feet, the problem is never spread — always load.

Building Design Factors

Because he stacks his merchandise on racks no dry grocery distributor today should build a warehouse with less than 20 feet of clear ceiling height.

For the architect this means adding enough to the 20 feet to accommodate all mechanicals and structure above that level, bracing included.

Speaking of wind bracing, there must be other and better ways of making sure a warehouse building will not twist or blow down. If the problem is explained, the client will usually settle for heavier structure. More steel tonnage may add a few per cent to the cost, but returns to usefulness a much larger per cent of the cube. Cross bracing at the bottom chord of a truss also makes it tough on the operator. If the ceiling height is 20 feet and the truss takes five, cross-bracing virtually guarantees an effective stacking height of only 15 feet. Thus the at-least-20-feet-under-whatever-lies-aloft rule.

In the dimension perpendicular to the shipping dock the column spacing of a palletized warehouse should express a given number of pallet loads. With the 32 inch face pallet some multiple of three feet plus one final foot always works if the columns are not over eight inches:

9 pallets at 32 in. equals.......	288 in.
10 clearances at 4 in. equals	40 in.
1 column....................	8 in.
12)	336 in.
	28 ft — 0 in.

Add any multiple of three feet and the spacing may be 31 ft or 34 ft, etc.

In the second dimension, parallel with the dock, the depth of a rack or stack plus the width of the aisle is the multiple:

Rack, depth for two pallets..............	7 ft
Aisle required by lift and load............	7 ft

Thus any multiple of 7 ft will do well

How about 42 ft?

And how about 28 by 42 ft? (Of course other dimensions apply with other pallet sizes.)

Floors and Floor Grades

Floors for food warehouses should be as good as skills can design and build. It never pays to try to save money on a concrete floor for a food warehouse. Where can the operation relocate while repairs are made? Besides, no one knows how to repair a concrete floor effectively.

Food warehouse operations, we have found, will not normally injure an honest six inch floor on good compaction — unless ruthless operators use steel-wheeled vehicles. However, we have seen four inch floors broken up by grocery loads. Steel wheels work havoc on floors. Rubber-tired and solid plastic wheels are available, and entirely satisfactory.

Expansion joints in grocery warehouse floors are another gremlin. The floor can and does chip away to some extent at these points. We prefer a sawed joint with the narrow slot filled with asphalt. Metal joints should be knife-edged, or they will break the wheels of jacks, wagons and other handling vehicles.

How high should the surface of the floor be above grade in the truck dock, and above the top of the rail at the siding?

Reason for confusion is that all heights of over-the-road vehicles bring in goods, and these vary as much as two feet between highest and lowest. It is impossible to adjust for all. Nor is there any way to predict the height that suits most.

One can tell exactly what the truck fleet of the warehouse requires, even though several kinds of trucks are used. The truck fleet can be measured and dock floor height adjusted accordingly. The dock slab height should be adjusted to truck height, loaded, so when empty the truck bed will be higher. It is wise to do this because in ramping down into a truck, the ramp has to extend well into the body. Ramping slightly up into any vehicle is preferable.

The same thing applies at the rail siding. Rail cars are not wide. If one must ramp down into them, insufficient turning space is left inside for the jack or lift truck.

Another good reason for relatively-low rail platforms is that cars differ markedly in floor height and many have hinged doors opening outward. These are the refrigerator cars commonly used to protect goods from sub-freezing temperatures in long winter hauls. If the dock is high, doors may not swing open between car side and platform. For these reasons, we like a nine foot space between platform and center of rail siding, and a 3 ft 6 in. height of platform over the top of the rail. The gap between the car side and platform of some cars then is nearly four feet, but that can be bridged easily, and the dimensions stated outguess all difficulties.

Where double rail sidings are necessary to carry more cars alongside, the two rail centers should be kept far enough apart to allow the doors to two refrigerator cars to open, letting the off car be worked through the nearer one.

Things to Come

As the multi-story warehouse toppled at the summit of its development, so will our now-wonderful streamliners. The shape of things to come is already visible. Manufacturers of materials handling machinery are asking themselves what they'll be making, say 20 years from now, when the only lift trucks extant will be in museums. Some of them are doing something about it — which tends to bring closer the date of accomplishment.

In time 80 per cent complete automation in distribution warehouses will be the rule. Goods will be handled by machines activated by magnetized tape. Machines will detect odors, read numbers, appreciate dimensions, work in the dark in one-story warehouses of towering height, without floors. The buildings, indeed, will themselves be machines, and instead of labor forces we shall have a small corps of technicians to keep the plant operative.

The only "labor" will be a small receiving crew directing inbound goods to slots by mechanics and electronics. Allow 10 per cent for the technicians and 10 per cent for the input crew, explaining the 80 per cent figure above. When this happens we shall be able to pay the technicians three times as much as labor earns today, and the inputters twice as much, while operating at half the labor cost.

Certainly this is a dream. But so was the Brooklyn Bridge, designed before Roebling worked out the detail of spinning the big cables on the job.

We have been told by the "brain" manufacturers that if we can think out what we want, and can afford it, they can make it.

So it is only a matter of time. Twenty years? Thirty?

And then, architects and engineers will house it all in buildings scarcely imaginable. Then, all we know now about warehouses for distributors can be filed away in a time capsule — to give our descendants a chuckle.

MODERN WAREHOUSE FOR FOOD DISTRIBUTION

Abner A. Wolf, Inc. Warehouse
Detroit, Michigan
Louis G. Redstone, Architect
C. L. Toonder & Associates, Mechanical Engineers

Lens-Art

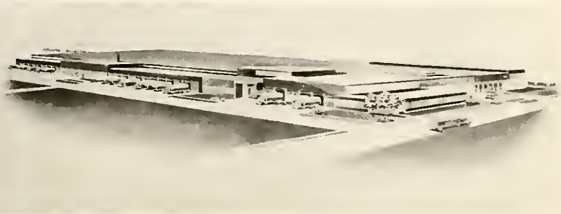
THE GREAT FLOOD OF PRODUCTS of industry must be sold, stored and moved to consumers, and the distribution process is rapidly becoming as scientific as manufacturing. The distribution inventiveness, and the buildings that go with it, is well illustrated in the food field, where both the volume and variety of goods force an intensive search for the most economical methods. Buildings for the handling of grocery products are called warehouses, for of course that's what they are, but the operations inside them may include all of the modern wholesaling functions.

The Wolf warehouse in Detroit is one of the large and well organized ones, a true wholesaler. But Manley Wolf, one of the brothers who have become in fact warehousing specialists as well as food sellers, laments that here their operation has so outgrown their building that some of their science has been snowed under. He nevertheless has outlined their methods, with special reference to their effect on building design.

"We operate with a 72 page order form. The customer orders the items in the amounts he desires and mails the form to us. Girls select tabulating cards for the items that he has ordered; these cards are then pre-sorted from their original order-form code sequence to warehouse lot sequence. They are then put into the IBM tabulating printer and an invoice is printed. This invoice has 3 copies; office, customer and warehouse. The warehouse copy is used by the selector to fill the order. The office and customer copy, kept together, are used to check the selected orders. The checker marks an X for items filled and an O for items not filled. This gives the customer a copy of the actual checking that took place.

"Our order selectors use 4-wheel trailers and electric towing tractors and select their orders on empty pallets, which, when full and checked, are loaded by fork trucks at the dock. This system of filling on pallets, though slightly less productive at the selection end, more than compensates at the loading end.

"We operate on a surplus selection system wherein order-pickers are travelling in a selection area which contains a representative amount of all items. The selection area, of course, is backed by the surplus area which contains the remaining stock. We feel that the additional intra-plant handling necessitated by this is more than compensated for by the shorter selection



walk of the order-pickers and therefore their greater production. We operate under a quasi-slot system, the slot number for each item being in effect the selection address number of the item. All items have a code number in our order form from which the customer orders and these are numerically in sequence by family groups. All tomato products are found in the same area of the order form and are in numeric sequence. These same tomato products are in different warehouse locations selection-wise. Thus, with the slot number system, we can keep our selectors in numeric sequence without confusing the customer order book which approximates store layout. Also, the separate slot number allows greater facility for moving items in the selection line. For instance, an item that is normally a slow mover and therefore in a less accessible selection area, might become a feature item at store level with a much accelerated movement. Thus, by merely changing the slot number, without any alteration at the customer level of ordering, we can put the item in question in its proper spot.

"We use 28-foot through 32-foot semi trailers almost exclusively in our delivery operation and average 80 loads per eight-hour day.

"In our receiving operation, we can receive 20 highway trucks at a time and can accommodate 14 railroad cars within our building.

"You probably know most of the architectural facts concerning our building, but in the event that you don't, here are a few pertinent ones. We have 40 x 40 bays. We have a clear usable height to the bottom of the trusses of 16′ which we find adequate for our 40″ x 30″ pallets. Our shipping docks are 240′ long and 51″ high. Our receiving dock is 200′ long by 30′ wide by 48′ high. The reason for the lower receiving dock height is to be able to accommodate more inbound trucks of varying truck-bed levels. Since it is an unloading operation, we're better off coming out of the truck with a down slope than the reverse.

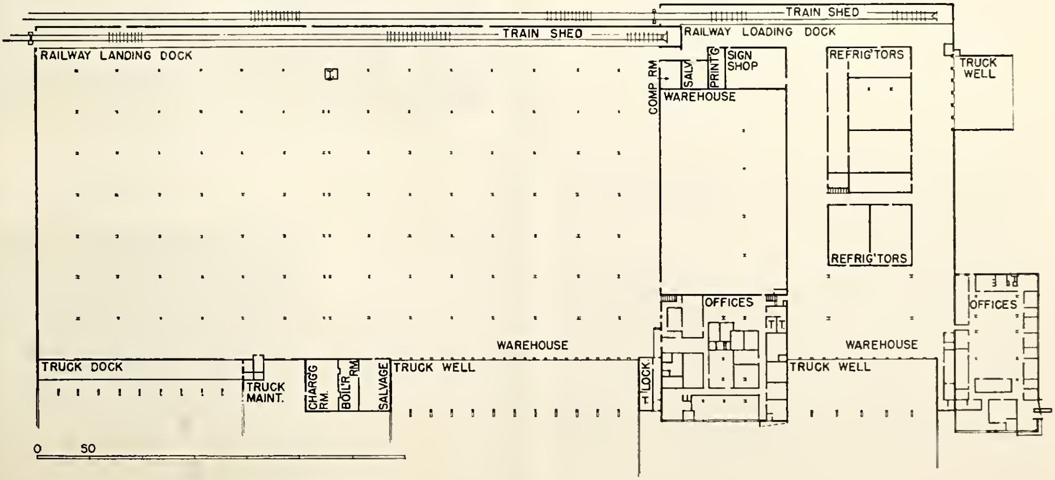
"In closing, I might mention some things of prime importance that we have learned in this building. Floors should be of adequate strength and proper finish. Adequate clear height is essential, pre-determined by the stocking height one's operation dictates. Above all, there should be an adequate electrical supply to handle greatly increased projected use in future handlings."

Constructed of steel, concrete and masonry, the building occupies 350,000 sq ft of a 12-acre site, with 38,000 sq ft devoted to office use, and 100,000 for expansion now going forward.

Foundation, reinforced concrete; frame, steel; enclosing walls, 6-in. concrete curtain with steel windows and steel deck facia up to roof. Interior walls, concrete block. Roof, tar and gravel, ¾ in. glass insulation over metal deck. Warehouse floor, 6-in. reinforced concrete with a hard "monorock" finish.

Average cost of building was $6.50 per sq ft, including warehouse, offices, cooler installation and refrigeration equipment.

Lens-Art


TRAIN SHED
TRAIN SHED
RAILWAY LOADING DOCK
RAILWAY LANDING DOCK
COMP RM
SALV
PRINTG
SIGN SHOP
REFRIG'TORS
TRUCK WELL
WAREHOUSE
REFRIG'TORS
OFFICES
OFFICES
WAREHOUSE
WAREHOUSE
TRUCK DOCK
TRUCK MAINT.
CHARG'G RM.
BOIL'R RM
SALVAGE
TRUCK WELL
LOCK
TRUCK WELL
0
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OFFICES AND WAREHOUSE FOR MICHIGAN STATE LIQUOR COMMISSION

Louis G. Redstone
and Otis Winn
Associate Architects

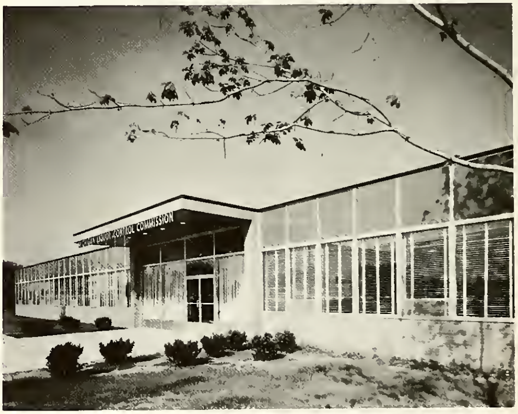
David J. Zabner, Mechanical Engineer

Building Division, Michigan
Department of Administration
Adrian N. Languis, Director

No doubt around Detroit this building is the subject of many a feeble joke, for it is the world's largest liquor warehouse, designed to contain 9,000,000 bottles of "packaged goods."

Like most modern warehouses, however, it was designed for the business-like and economical handling of goods, in this case both local and state liquor storage and distribution at the wholesale level. Its dual purpose accounts for the fact that it is really two separate warehouses, with two separate truck wells.

Like many another of the representative "warehouse" buildings in other distribution fields, it is also a sort of home-office-in-the-field, with fairly important



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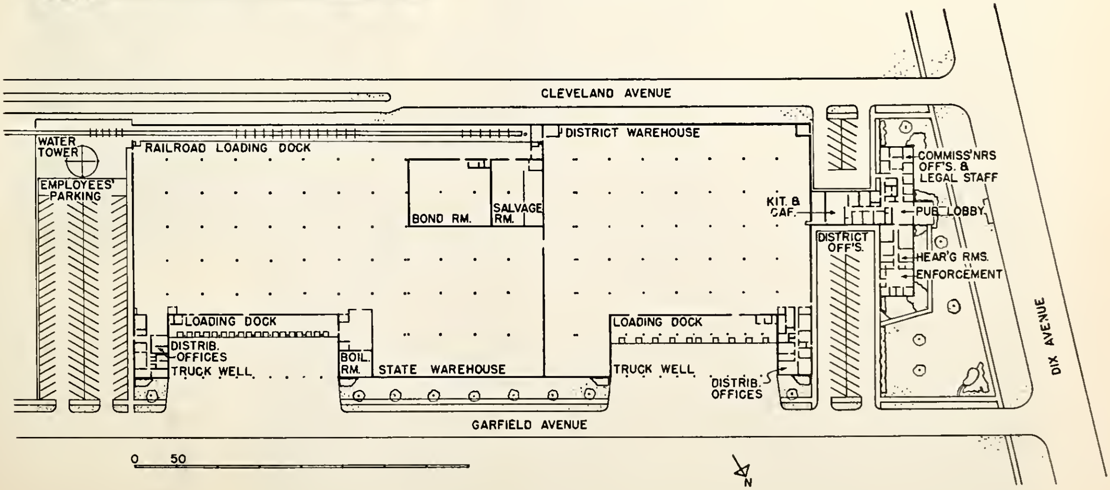

CLEVELAND AVENUE
WATER TOWER
RAILROAD LOADING DOCK
DISTRICT WAREHOUSE
EMPLOYEES' PARKING
BOND RM.
SALVAGE RM.
KIT. & CAF.
COMMISS'NRS OFF'S. & LEGAL STAFF
PUB. LOBBY
DISTRICT OFF'S.
HEAR'G RMS.
ENFORCEMENT
DIX AVENUE
LOADING DOCK
DISTRIB. OFFICES
TRUCK WELL
BOIL. RM.
STATE WAREHOUSE
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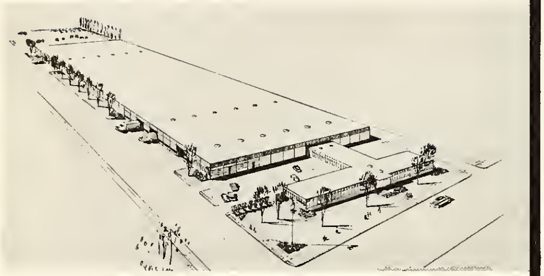


stature as an office building. Here are housed the state liquor control commissioners, legal staff, office staff, enforcement group, district staff, complete with kitchen and cafeteria, all completely air conditioned.

The warehouse portions contain 240,000 sq ft, disposed in a rectangle 800 ft long by 300 ft wide. A railroad spur extends into the building to bring as many as 10 freight cars to the incoming platforms. Outgoing deliveries are by truck, and the two truck wells can accommodate 40 trucks. Manually operated levellers facilitate loading.

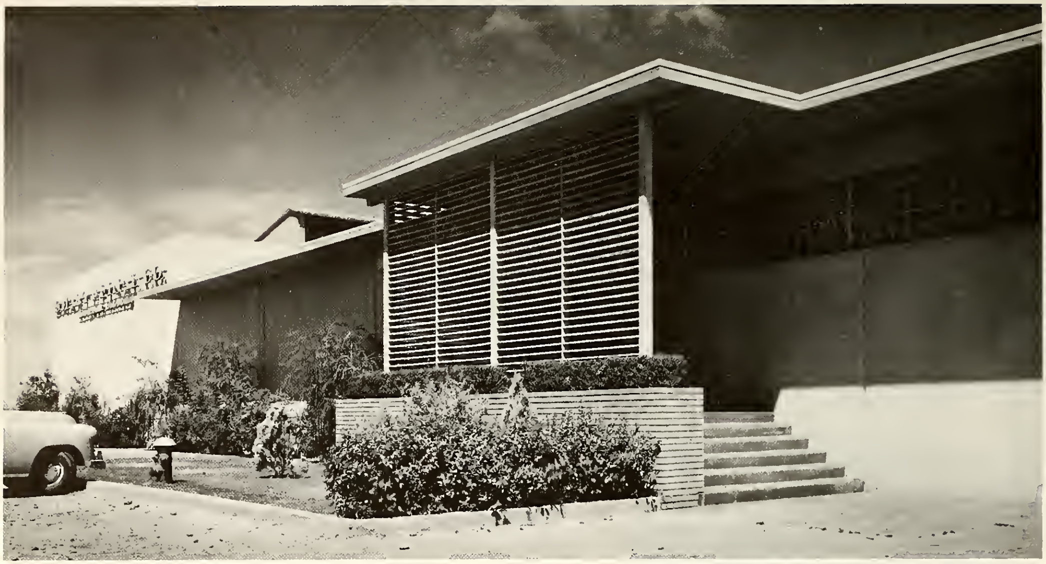
Warehouses used fire-resistive construction, with steel beams and columns, steel joists, metal roof deck. Exterior walls are 8-in concrete, 12 ft high, with upper section of corrugated asbestos. The warehouse fire protection system comprises automatic sprinklers, fed from a free-standing 100,000 gallon water tank and 100-gallon-per-minute fire pump.

Lighting in the warehouses uses the new 480-277-volt, 4-wire, 3-phase system. Heating is by unit heaters served by 10-lb steam, with vacuum returns. Ventilation system employs controlled sectional intakes and exhaust to obtain full coverage without dead spots.

Cost of the building, both office and warehouse, was $5.76 a sq ft, including all site improvements. This cost is reported to be 20 per cent under the appropriated amount.

HIRAM WALKER'S
GLASS THIS SIDE UP WITH CARE
GLASS THIS SIDE UP HANDLE WITH CARE

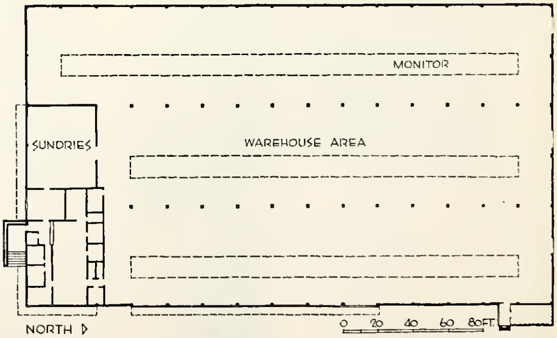
Lens-Art



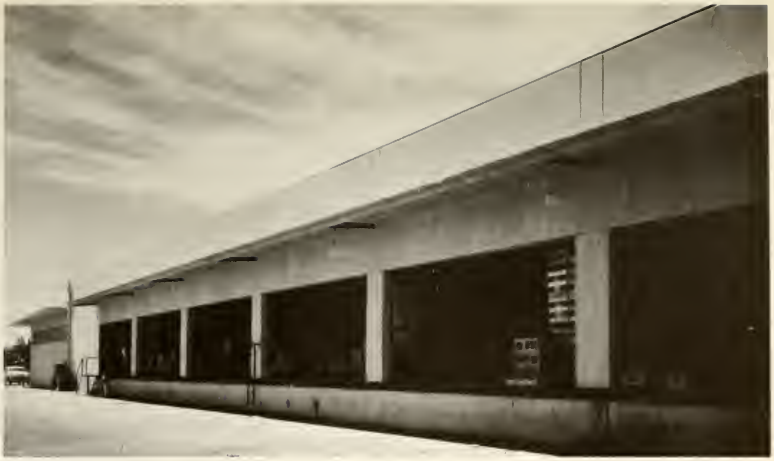
WAREHOUSE AND OFFICES FOR WHOLESALE GROCER

For Smart & Final Co., Phoenix, Arizona
McClellan, MacDonald & Markwith, Architects
Buttress & McClellan, Inc., Contractors

In some lines of business, the true wholesale concern seems to have disappeared, but here is one manifestation of a wholesaler who seems to be very much alive. The new building, measuring 100 by 300 ft, is largely warehouse space for grocery products, but there is a small group of offices. While the building is economical, its street front is designed to bring out the office portion, and to take full advantage of advertising value. The structure employs a system of precast concrete panels and welded light steel frame patented by the contracting organization. The 100-ft width of the building is divided into three spans; column spacing in the other direction is 20 ft. Roof is arched over the longer spans, but the arch is modified by monitor sections which run virtually the length of the building.

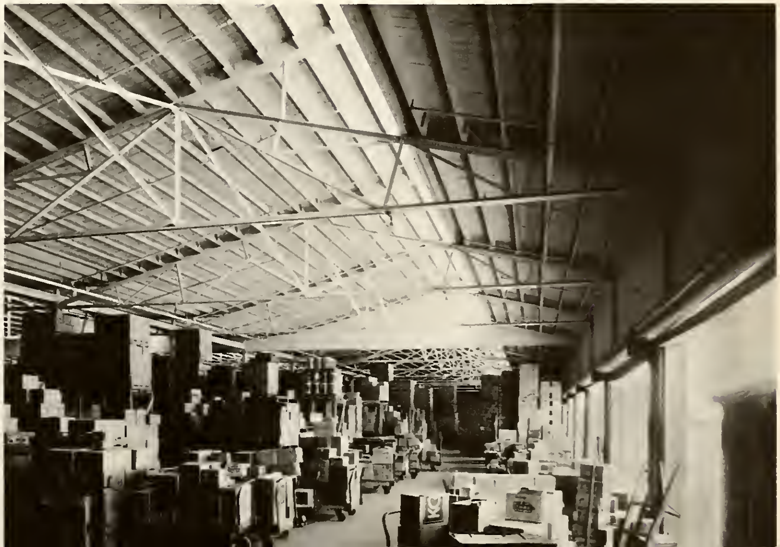


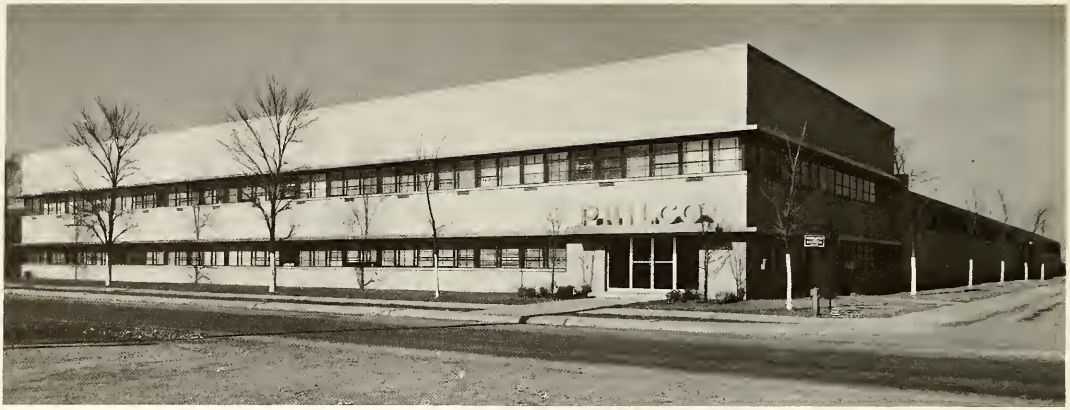
Truck docks occupy nearly all of one side of the building, each opening being virtually the full space of 20 ft between columns



Stuart A. Weiner

Dock openings are closed just by rolled up mesh screens. Interior has 19-ft ceiling, gets daylight from three long monitor sections

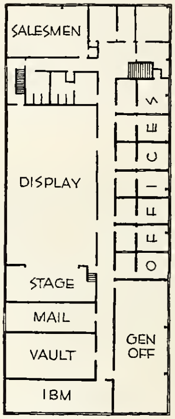




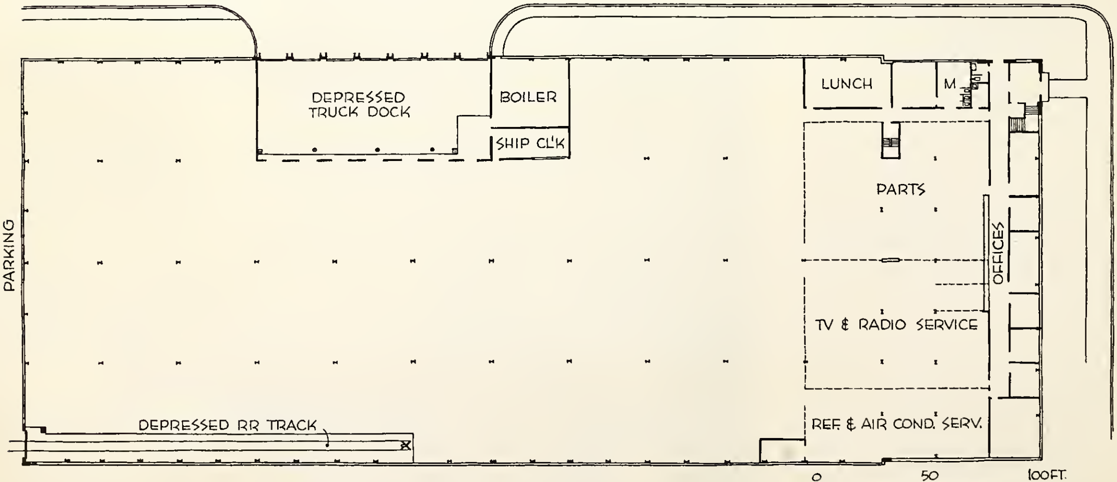
WAREHOUSE AND OFFICES FOR PHILCO

Clearing Industrial District, Chicago
John S. Cromelin, Architect

A FAIRLY TYPICAL TYPE of building in today's distribution systems, this one houses sales offices, display, service department and warehousing for Philco Distributors, Inc. The warehouse portion is quite large, is served by a railroad siding and a large truck dock. Executive offices are air conditioned with a central system for interior spaces, individual room units in rooms along the outside wall; these are used also as display units, will be replaced as models change. Note line of grills along second floor for air intakes. Construction is of light steel frame, masonry walls, concrete floor.

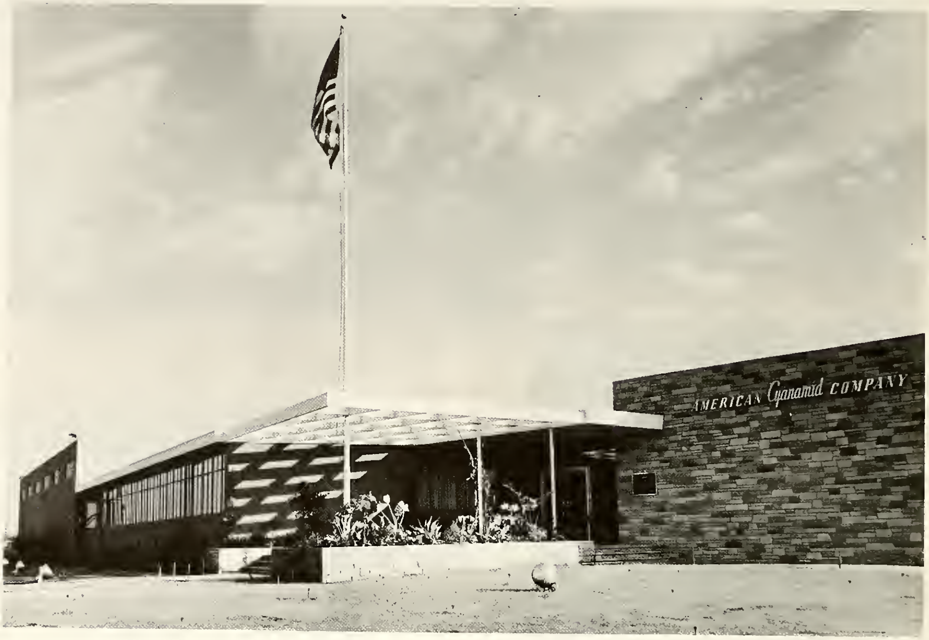


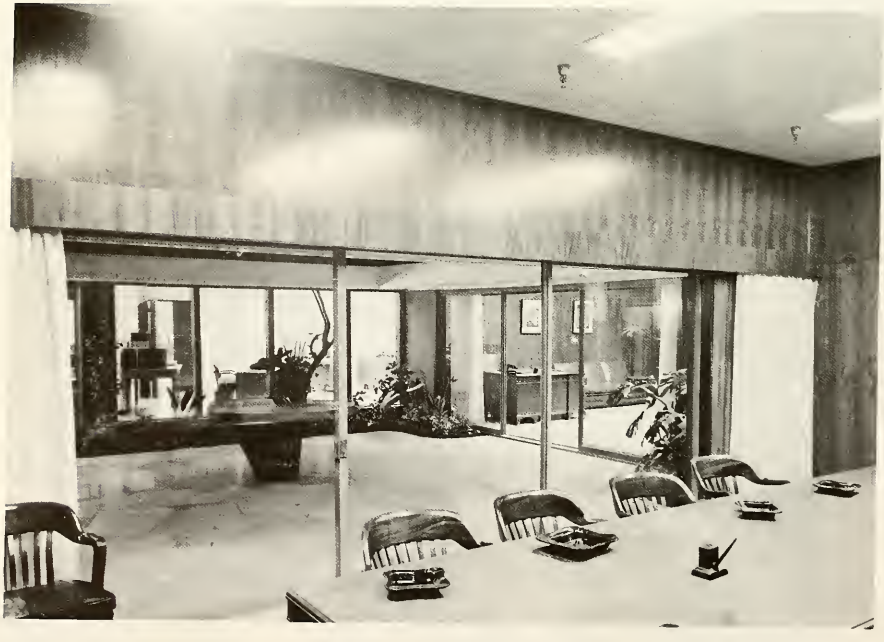
SECOND FLOOR



Hedrich-Blessing

CONSOLIDATED OFFICES





AND WAREHOUSE BUILDING

American Cyanamid Company Building, Los Angeles

John M. Stahl, Owner

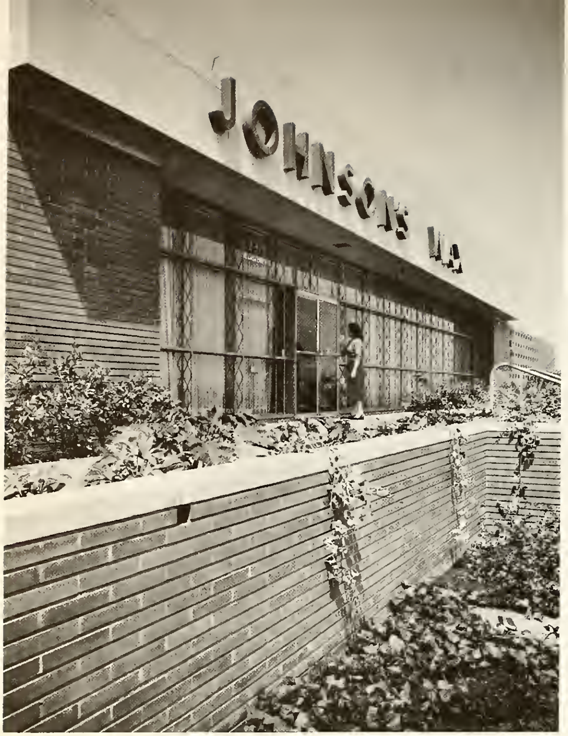
McClellan, MacDonald & Markwith, Architects

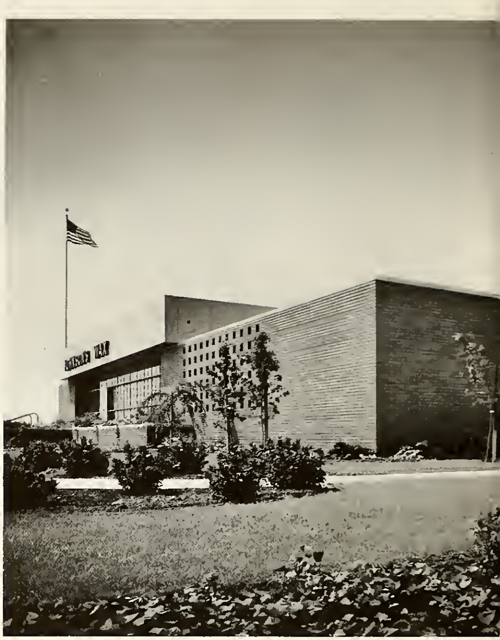
M. J. Dean, Designer Associated with Owner

Buttress and McClellan, Contractors

CONSOLIDATION was the *raison d'être* for this little building, consolidation of several office and warehouse locations in the Los Angeles area. Cyanamid does not own it; it was built for them by the owner under a long-term lease.

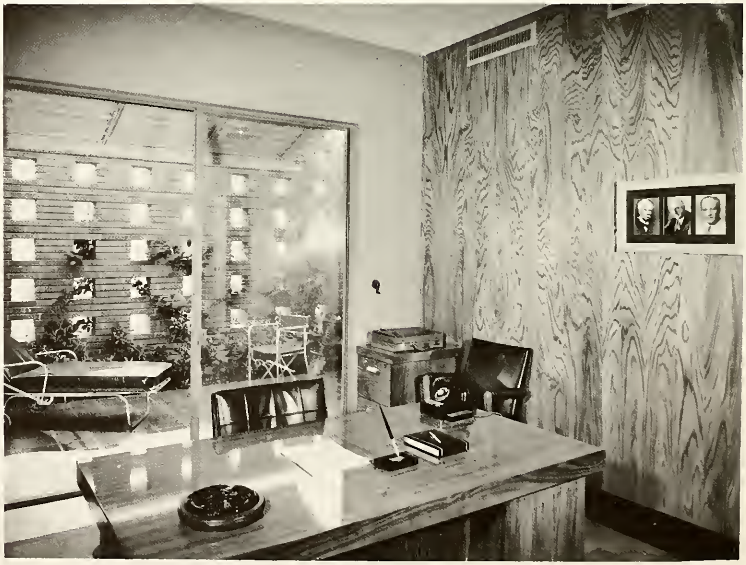
The building has 44,700 sq ft of warehouse and 18,100 sq ft of office space. It is of pre-cast slab wall construction, the slabs poured one on top of the other, then set in position and joined by poured columns. Wall slabs are poured on floor slabs protected by Hunt's process from adhering. A stack of wall panels may be poured one on top of the other, with windows framed in and reinforcing bars projecting out the sides. Concrete is vibrated after being poured and one surface troweled smooth for an interior finish. Panels are then lifted into position, steel projections welded together, column steel forming set and the column poured.



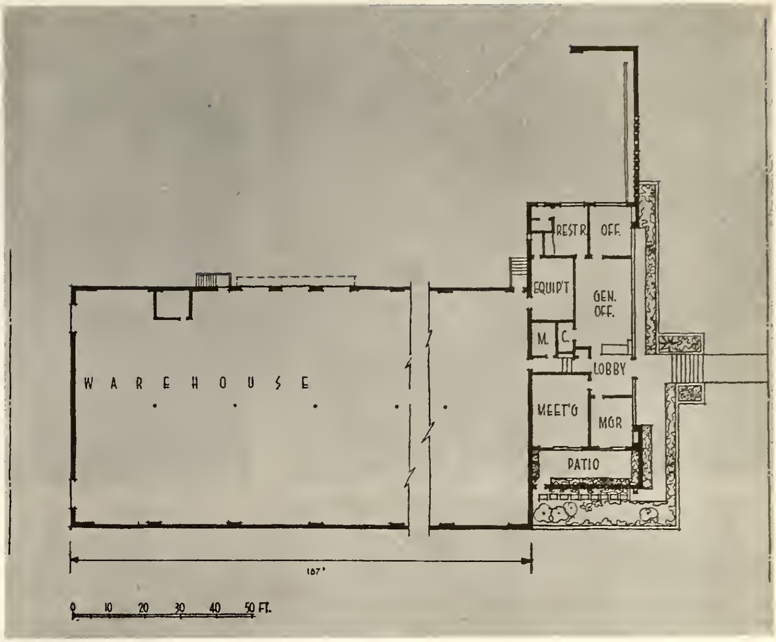


WAREHOUSE BUILDING

District Offices for S. C. Johnson & Son, Inc., Los Angeles



Photos: Julius Shulman



FOR FUTURE MANUFACTURING

Albert C. Martin and Associates, Architects and Engineers

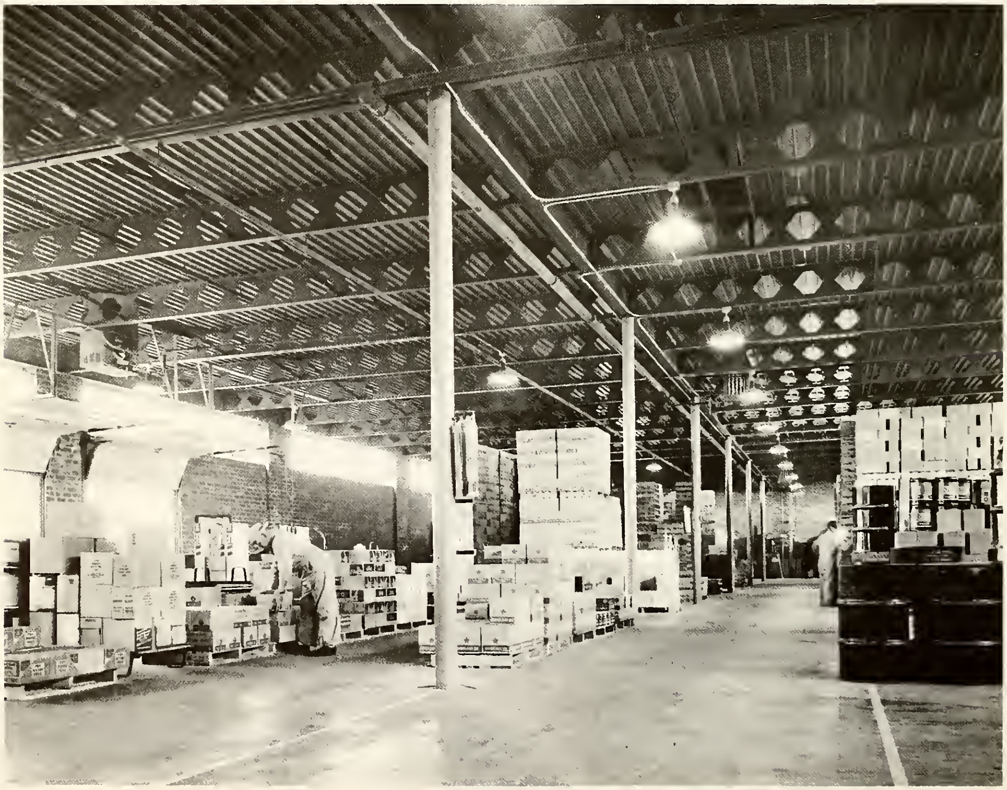
This building was awarded an honorable mention in the Honor Awards Program held by the Southern California and Pasadena chapters of the A.I.A. "Plan was simple and direct," said the jury report, "with fine relation between office and warehouse. The interior of the warehouse has real beauty . . ."

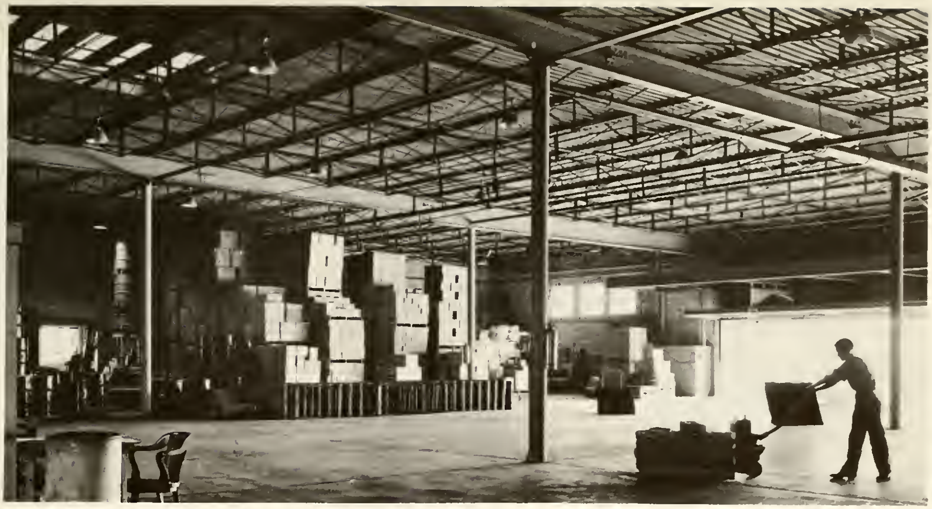
Distribution of nationally advertised products on the West Coast frequently calls for a building such as this, a district office building and warehouse planned for later manufacturing operations. In such an enterprise the site is chosen with consideration for both administrative and truck traffic, in this instance in a fast-growing industrial area southeast of Los Angeles proper. Site and building are planned to allow for expansion of both office portion and manufacturing space. And architectural values are developed for both prestige and advertising purposes.

Structure is reinforced brick masonry, using common brick for the warehouse and face brick for the office portion. Windows are steel sash, mechanically operated in the warehouse. Floors are quarry tile in the patio, slate on the terrace; office floors are covered with rubber tile, asphalt tile, linoleum, cork tile and hardwood parquet floors. In the warehouse floor is concrete, treated to increase its hardness and to control cracking. Walls in the warehouse are exposed brick; office walls are finished with several species of hardwood paneling, natural wax finish. Acoustic tile ceilings; fluorescent lighting.

Walled-in patio at one end of office building provides a pleasant outlook for the district manager's office, and for the sales meeting room (upper left). Sliding doors open these rooms to the patio

Photos: Julius Shulman



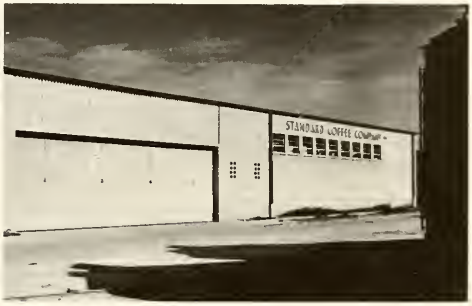


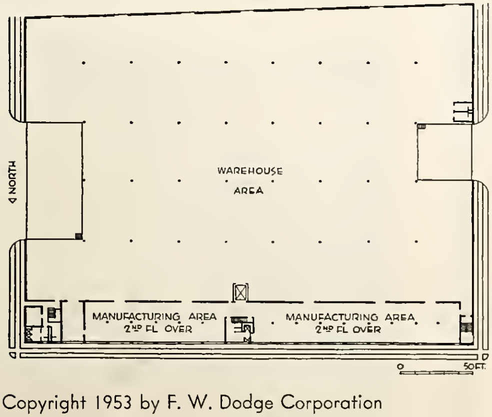
Joseph Molitor

DISTRIBUTION CENTER FOR HOUSEHOLD GOODS

Warehouse for Standard Coffee Company,
New Orleans
Richard Koch, Architect

COMPLICATIONS in selling systems, as might be anticipated, lead to many different combinations of warehouse, sales and service buildings. This one is a building for a truck-to-door selling system. Coffee and other staples, including blankets and kitchen utensils, are stored here, sent out by large trucks to various selling agents. Small-scale manufacturing is done in the two-story part of the building, but the principal activity is warehousing. The building is located on the water front, and has a rail siding, but three-fourths of its incoming products arrive by truck. Building is done economically but pleasantly with concrete block and brick walls, steel pipe columns, steel beams and joists.




WAREHOUSE AREA
MANUFACTURING AREA 2ND FL OVER
MANUFACTURING AREA 2ND FL OVER
NORTH
0
50FT.

DISTRIBUTION CENTER FOR ELECTRICAL GOODS

Sales and Warehouse Building for
Central Electric Supply Company
Denver, Colorado
Stanley E. and Jared B. Morse, Architects

Winter Prather

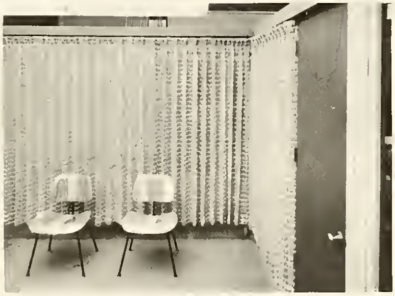
THIS "WAREHOUSE" EXEMPLIFIES a general type of building which is seen in increasing numbers as industry's distribution system expands. While the strictly warehouse function is, space wise, the largest, there would be little reason for a warehouse without the display, sales, service and general office work that also goes on here. Nevertheless it is frequently the materials handling operation that forces the construction of the building, and that strains the designers to plan buildings and facilities for the utmost efficiency in receiving, sorting, storing, packaging and shipping goods.

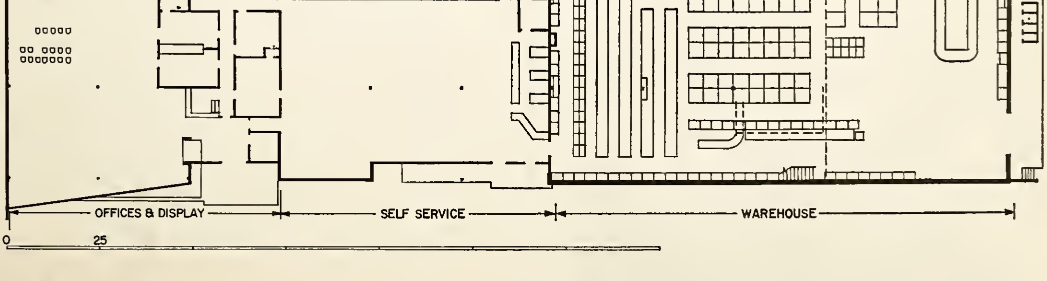
Here these problems were turned over to the architect, to devise systems of handling the seemingly infinite variety of electrical supplies, ranging from tiny parts to great reels of cable. One can guess that he found it a fertile field for the kind of ingenuity that finds daily exercise in an architect's office.

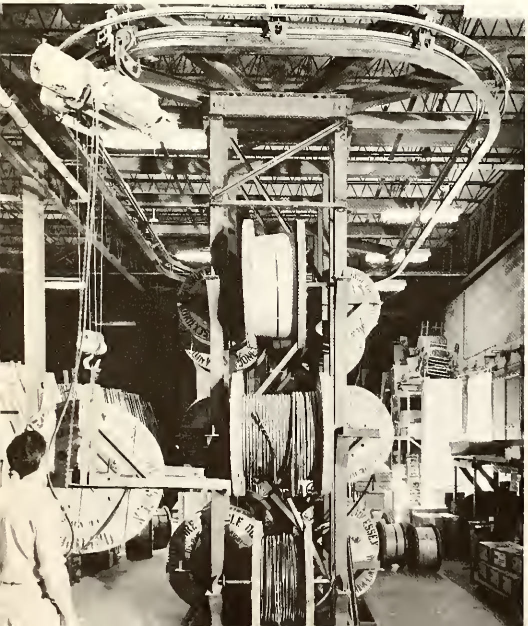
The building serves three types of customers. The display area (left portion of plan) is to promote the sale of light fixtures on a retail basis. Fixtures are mounted on panels and are inserted into the ceiling grid to simplify changing them. Small orders are filled in a serve-yourself area (left center of plan). Large orders are collected from the mezzanine area, assembled at the carton slide, wrapped, weighed and shipped.

Office partitions are removable in four-foot sections. They are designed so that uniform light and air conditioning can be employed for one large area. The cornice of the partitions is recessed to house electrical conduit. The architect reports that these partitions have proved very easy to maintain and are extremely economical. As the photographs indicate, acoustical treatment is liberally used.

It seems to be standard practice in buildings of this type to plan considerable expansion in the original scheme, then to start that expansion soon after the building opens. Here the first phase has begun with the addition of a mezzanine over bays 8 to 10 (from the left). Eventually conduit will go to a new building.



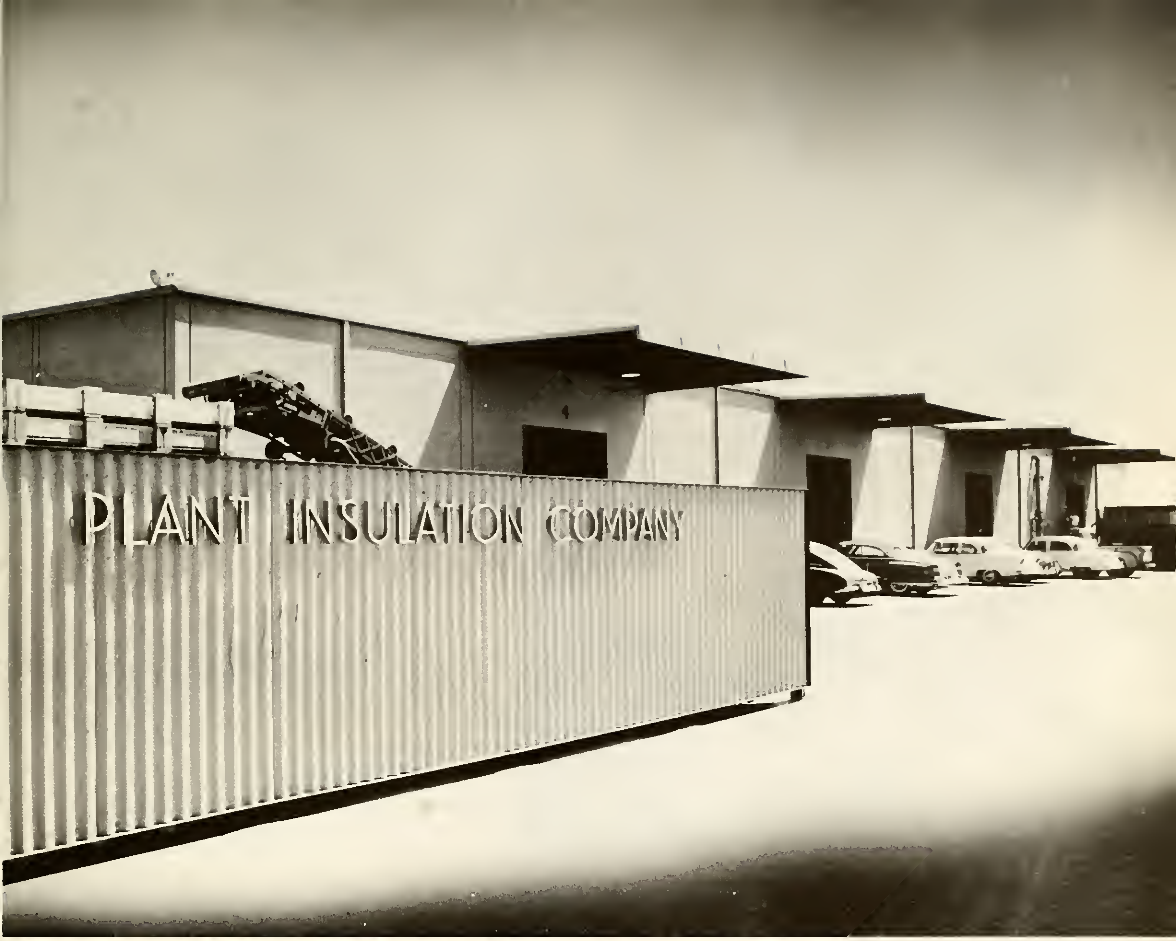

OFFICES & DISPLAY
SELF SERVICE
WAREHOUSE
0
25



Shelving indicated on the plan is all of steel; conduit racks were designed for steel but were adapted to Unistrut construction. The special rack for cable reels was employed to conserve floor space. The carton chute was devised to simplify the work of packing a great variety of items.

Due to foundation problems, the building is supported on caissons. Main floor is reinforced concrete. Frame is steel; all walls ore concrete block, glass and asbestos-cement panels. Roof deck is flat, poured gypsum.

The building was planned for expansion to the north, west and south. A mezzanine is now being added in one part of the warehouse; it is planned to move the conduit part of the operation eventually to a separate building.



Julius Shulman

OFFICE-INDUSTRIAL PLANT BECOMES SHOWCASE

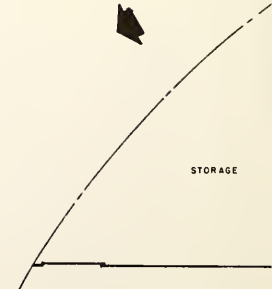
The Plant Insulation Co., Los Angeles, Cal.

Smith & Williams, Architects; Warren Jones, Landscape Architect; Mac Isaac & Menke, Contractors

This combination office-industrial building houses a rapidly growing, eight year old company devoted principally to the warehousing and distribution of insulating materials, and to the performance of contracting services over a four state area. Their new building comprises three main elements: an office wing, a warehouse building, and a small manufacturing plant. The three structures connect only as function requires, and their organization results in a clear expression of use, good visual screening to separate activities of different kinds, and a well organized traffic pattern.

Since the site is hot and dry, the entire office wing is air conditioned, and is insulated by a complete (floor, walls, roof) sheath of glass foam 2 in. thick. The finish ceilings are of the company's insulating cork, and both flat and corrugated asbestos panels (also handled by the company) are used for exterior and interior finish. Thus the building becomes, in effect, a showcase for the display of the owner's products in use.

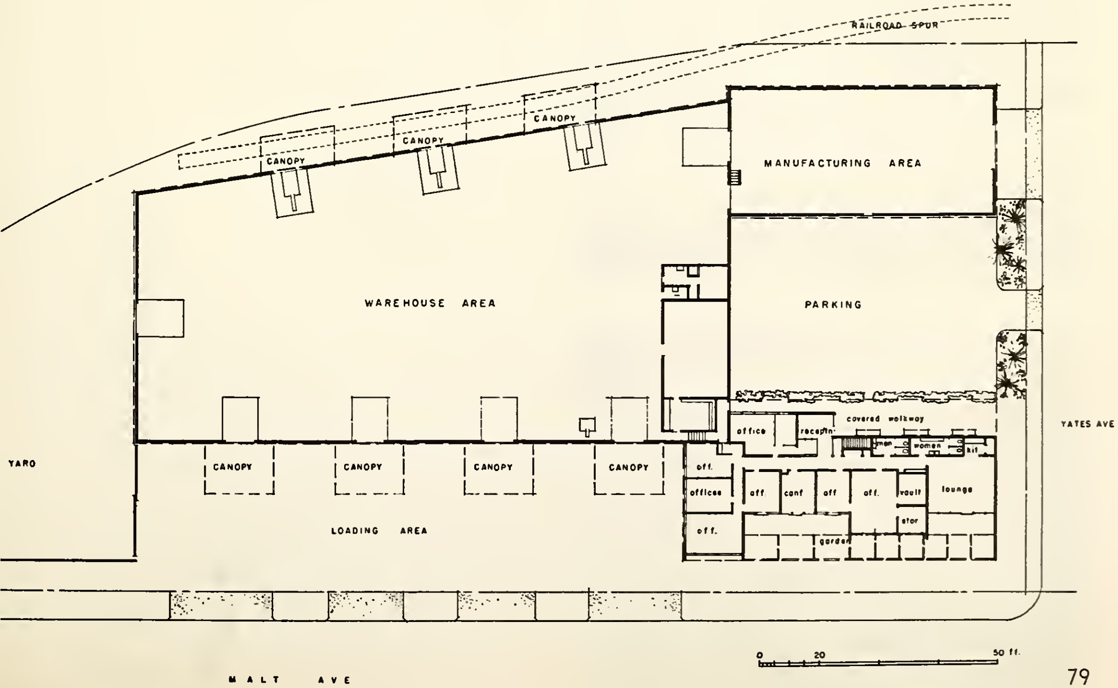
The structure is located in the Central Manufacturing District of Los Angeles, an area of 3400 acres which contains over 600 industrial buildings. The District — a planning story in itself — offers wide streets, adequate rail spurs, setback regulations, restrictions on the use of certain materials, etc., and is well placed for convenient access to the freeway system.

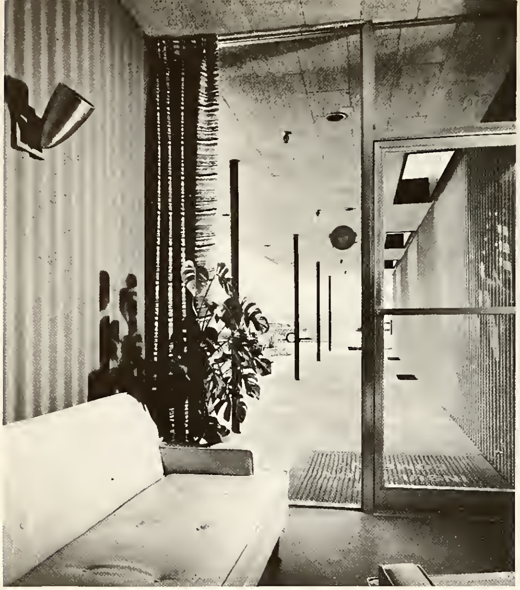

STORAGE

Julius Shulman

THE EXTERIORS *are varied in aspect, as are the activities within the three main elements: above, the office wing and gardens; left, the parking area and entrance walk; bottom left, the series of canopies which are spaced to align with the standard openings in freight cars*

THE PLAN *clearly expresses the three part function of the building and shows the disposition of the three kinds of traffic serving those functions. All material arrives by rail and is unloaded into the warehouse area for straight-line handling to the truck docks opposite, where it is loaded for distribution. A portion may be processed (for contract work) in the manufacturing wing, which has its own truck dock. Automobile access and parking is carefully separated from the other traffic*

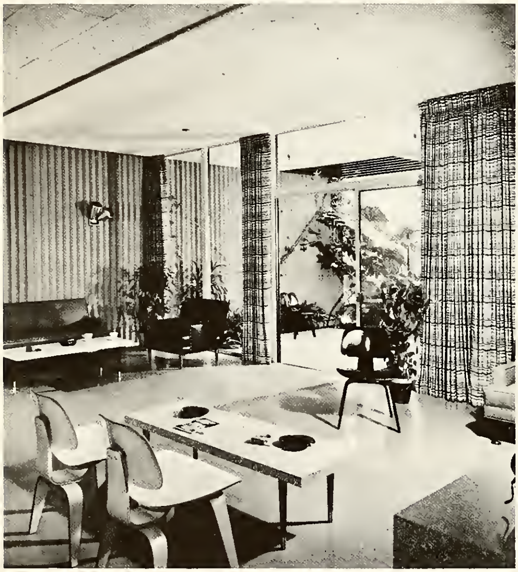


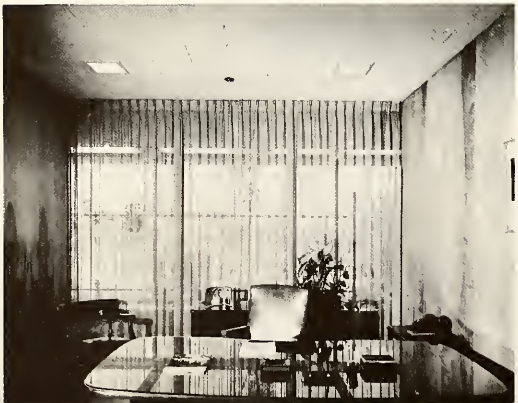


PLANT INSULATION COMPANY

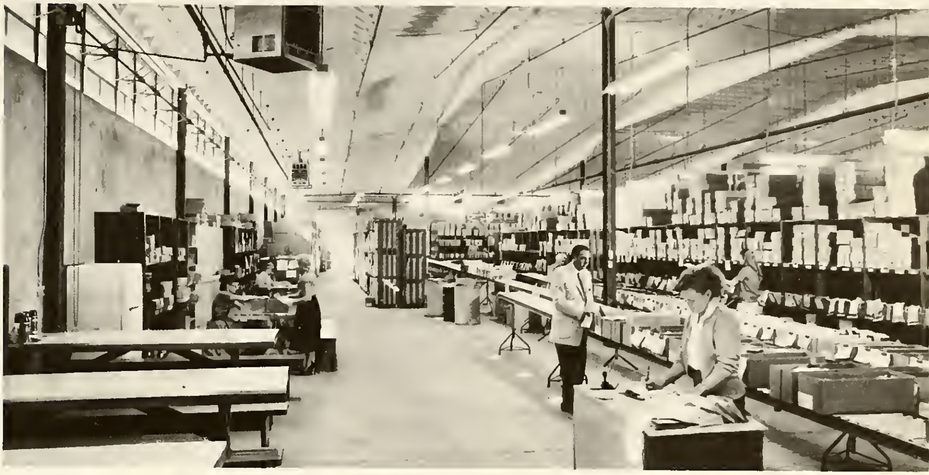
THE INTERIORS *are conceived both as a strong factor in building favorable employe morale and as a showcase for the company's acoustical products. Color, materials and furnishings have been carefully considered with these ends in mind.*

From the parking area, visitors and office workers gain entrance by way of a shady covered walkway and attractive lobby, shown above. The colorful lounge, with adjoining kitchen and garden, center, is devoted principally to employes' activities; is used by executives only for occasional special functions. The bottom picture shows a typical executive office and adjacent garden





Julius Shulman



Julius Shulman

LOW COST WAREHOUSE

West Coast Headquarters Building, American Greetings Corporation
Los Angeles, California
Kenneth N. Lind, Architect

A FAIRLY TYPICAL NEED, especially on the West Coast, is buildings to warehouse products for area distribution. The warehouse portion must be built at absolutely minimal cost since handling costs are always under close scrutiny; especially for a low-unit-cost product like greeting cards; yet part of the building must have enough impressive quality to serve as area offices. Low cost was achieved here with concrete tilt-up construction. The interior of the building is exposed concrete; office areas are gray with oyster white, pale ice green and a darker gray green. The exterior is white and gray with accents of yellow at the facias of the office portion.

DOCKING FACILITIES FOR MOTOR TRANSPORTS

The primary consideration in planning modern loading and unloading facilities for motor transport equipment is to provide adequate space for efficient maneuvering into and out of loading position at properly constructed docks. No one plan will fit all requirements, but careful study of present needs and future possibilities will determine the type and size of facilities essential to efficient operation.

There is, of course, no set of standard dimensions covering the space required for maneuvering the many possible combinations of tractor-trucks and semi-trailers into and out of loading position at docks or in stalls and driveways. However, the maneuvering space required is largely dependent on three factors: (1) overall length of the tractor-trailer unit; (2) the width of the position in which the vehicle must be placed; and (3) the turning radius of the tractor-truck which pulls the unit. Inasmuch as a tractor-trailer uses slightly more space to pull out than to back in, all reference to maneuvering apron space is based on the requirements for pulling out.

LENGTH OF TRACTOR-TRAILER UNIT

The length of tractor-trailer units to be accommodated will vary in accordance with state laws and differing types of operation. Analysis of the specific problem will give the answer as to the largest vehicle to be considered in your planning. However, for the purposes of this discussion, tractor-trailer units of 35, 40 and 45 ft. are considered as being the most prevalent overall lengths. If an appreciable volume of traffic is handled by "for hire" motor transport, it may be expected that the unit length to be accommodated will approximate the legal limit in the state concerned, usually about 45 ft. (see Table I). It is obvious that commercial haulers will use the maximum size tractor-trailer practical for efficient operation within state limitations. In general, it may be assumed that straight trucks can be accommodated in the space required for tractor-trailer units inasmuch as it has been impractical to build trucks even approaching the length and cubic capacity of modern trailers. In some states trains of more than one trailer are permitted. Such equipment is not being considered as it is assumed that each trailer in a train would be spotted separately.

WIDTH OF POSITION

The maximum allowable width of a truck or trailer is 8 ft. and it may be assumed that virtually all units (other than those for light city delivery) are built to take full advantage of this dimension. It is the consensus of opinion among transport and traffic men interviewed that 12 ft. is a very desirable width for doors, stalls, or other positions. Slightly narrower position widths can be utilized when necessary but should be avoided in order to reduce the possibility of damage to equipment and loss of time for jockeying into position. Also, as position width increases, the apron space required for maneuvering will decrease.

TURNING RADII OF TRACTOR-TRUCKS

The turning radii of tractor-trucks have a definite bearing on the apron space required for maneuvering equipment. However, because of the variation in this dimension among trucks of different types, capacities and makes, a high average turning radius has been used in arriving at recommendations regarding space requirements (see Table II, page 83). The requirements of heavy-duty units with extremely long turning radii have been omitted from the table. If such equipment is a factor in any operation, a special study should be made to determine the space required. Units utilizing cab-over-engine truck-tractors will have somewhat shorter turning radii for the same lengths and, consequently, will require less apron space than units with conventional tractors. At the present time, it is recommended that the shorter turning radius of the cab-over-engine tractor be ignored in planning loading facilities. Many of these tractor-trucks are in use, but few shippers can count on their exclusive use.

TABLE I — STATE LENGTH LIMITS* OF TRACTOR-SEMI-TRAILER UNITS

State	*Ft.*	*State*	*Ft.*	*State*	*Ft.*	*State*	*Ft.*
Alabama	45	Indiana	40A–45T	Montana	60	Pennsylvania	45
Arizona	65	Iowa	45	Nebraska	42	Rhode Island	45
Arkansas	45	Kansas	45	Nevada	NR	South Carolina	50
California	60	Kentucky	45	New Hampshire	45	South Dakota	50
Colorado	60	Louisiana	50	New Jersey	45	Tennessee	45
Connecticut	45	Maine	45	New Mexico	65	Texas	45
Delaware	50	Maryland	55	New York	50	Utah	60
Dist. of Columbia	50	Massachusetts	45	North Carolina	48	Vermont	50
Florida	50	Michigan	50	North Dakota	45	Virginia	45
Georgia	45	Minnesota	45	Ohio	45	Washington	60
Idaho	45	Mississippi	45	Oklahoma	45	West Virginia	45
Illinois	45	Missouri	45	Oregon	50	Wyoming	50

A — Actual Law T — Temporary Allowance NR — No Restriction

* The above digest was compiled from information available as of August 1, 1947, but is subject to change. It is suggested you consult your State Trucking Association or Highway Department for more recent or prospective changes in these limitations.

By Fruehauf Trailer Company, Detroit.

APRON SPACE REQUIRED

The apron space required to maneuver tractor-trailer units into or out of loading position in one maneuver has been worked out in practical tests with standard equipment handled by experienced drivers. Inasmuch as a high average turning radius has been arbitrarily used to provide a margin for differences in equipment, the variable factors were overall length and position width. *The apron space required is measured out from the outermost part of any vehicle or other possible obstruction in the area of the maneuver.*

In the case of a single-position unobstructed dock (a), the distance would be measured straight out from the dock. However, if a canopy or roof, supported by posts (b), should be present to protect the loading area, the distance would be measured out from the posts. If it is necessary to spot a trailer alongside another vehicle (c), the distance would be measured from the outermost point of the vehicle obstructing the maneuver. When a stall or driveway is involved (d), the distance would be measured from the outermost obstruction, such as a curb, pole, or vehicle, etc. To facilitate planning, a table of dimensions (Table II) has been prepared as a guide on space requirements for the most efficient maneuvering of motor transports into and out of loading position, in *one* maneuver.

The figures in Table II do not include margin for driver-error or any provision for congestion, storage or parking of equipment. It is highly recommended that at least the minimum apron space be allowed and that it be kept clear for the approach and maneuvering of transport units.

In locations where the proper space is not available for parking in one maneuver, trailers can be jockeyed into position. This, however, is a time-wasting, costly, and unsatisfactory process for both commercial and private transport operators.

OVERHEAD CLEARANCE

Standard trailers vary in height up to 12½ ft. Consequently, it is recommended that 14-ft. clearance be provided at docks or in yards, driveways, doors, stalls and interior roadways. Special transportation conditions such as delivery of large machinery may require greater clearance.

DRAINAGE

Roofs or canopies over loading docks should be constructed so as to avoid drainage into the loading area. This precaution will reduce the hazards of mud and ice and the resulting loss of traction. It is particularly important to prevent ice formation on the pavement where tractor and trailer are coupled.

SHUTTLE OPERATION

In many instances, consideration should be given to space requirements at docks, or in yards or buildings, for parking trailers used in shuttle operation, a system utilized in many industries to take advantage of its inherent savings in equipment and labor. Basically, shuttle operation consists of handling two or more trailers with one truck and driver. While one trailer is in transit, another may be at a dock unloading, while a third is being loaded.

TRAFFIC CONGESTION

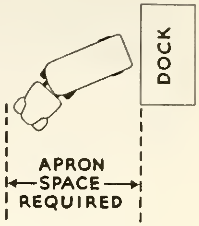
So far as possible, loading areas and approaches should be free from general traffic and obstructions. Railroad crossings, automobile traffic, parked vehicles, and material carelessly stored outside all contribute to delays in pick-up and delivery.

PITS AND RAMPS

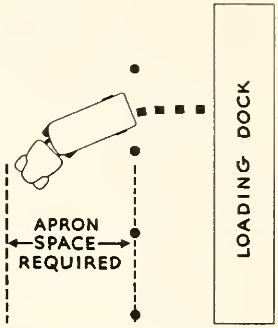
When the use of loading pits and ramps is unavoidable, several factors deserve careful attention. Types of transports, and their loads, should be studied to determine the maximum practical grade which can be negotiated. It may be easy to back into a pit — but can the load be

TABLE II — "APRON SPACE REQUIRED FOR ONE MANEUVER INTO OR OUT OF POSITION

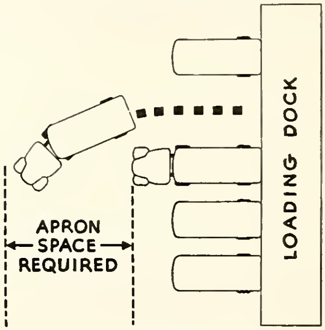
Length of Tractor-Trailer	*Width of Position*	*"Apron" Space*
35′	10′	46′
	12′	43′
	14′	39′
40′	10′	48′
	12′	44′
	14′	42′
45′	10′	57′
	12′	49′
	14′	48′



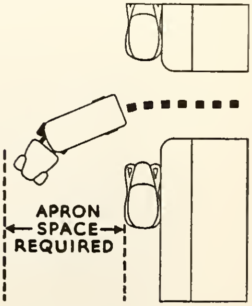
(a) Unobstructed dock



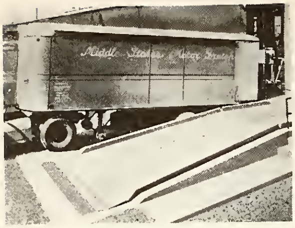
(b) Post-supported canopy



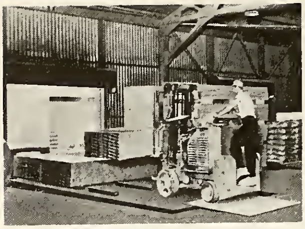
(c) Alongside other vehicles



(d) Driveways and stalls



Adjustable loading ramp raises or lowers trailer to the desired level



Metal plate facilitates the use of materials handling equipment

Platform adjusts for differences in level. Hinged plate bridges gap

pulled out? Furthermore, such installations should be protected against ice and mud so that power will not be lost through poor traction.

BUILT-IN TRANSPORTATION

More and more interest is being evidenced in the possibilities offered by the use of "built-in" or "run-through" facilities. In many cases, spot delivery inside the plant will facilitate handling of heavy material, or direct delivery to an assembly line or other point may eliminate costly re-handling. A straight one-way "run-through" need be only 10 ft. wide to provide minimum clearance for the 8-ft. maximum width of a transport unit. However, other traffic, unloading problems, or special considerations such as delivery of special equipment on flat-bed carry-alls might require extra width, and possibly greater overhead clearance than the 14 ft. previously mentioned. If a right angle turn must be negotiated in a narrow driveway, extra clear space should be provided on the inside of the turn to eliminate maneuvering.

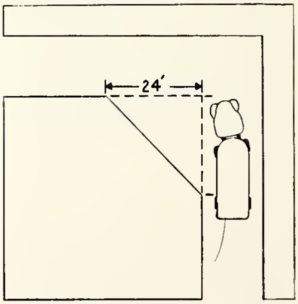
For instance, in a driveway 12 to 14 ft. wide, the triangular area, formed by the inside corner of the turn and the two points 24 ft. on each side of the corner, should be left clear. This will allow proper clearance for the turning radius of the tractor-truck and the cut-in of trailer wheels.

LOADING LEVEL

A troublesome factor in loading and unloading at docks or loading platforms is the inherent variation in loading level (distance from pavement to floor level) of motor transport equipment. This distance averages 51 in. for heavy equipment but varies within a 6-in. range depending on model, tire size, and load. Due to spring compression, a heavily loaded trailer may be 3 in. lower than when empty. Also, one model trailer may be equipped with any one of a number of tire sizes, depending on the load it is required to carry. This factor can cause a variation of as much as 3 in. in loading level. Dock heights of from 44 to 50 in. are in general use, but only an analysis of the specific operation can determine the proper answer to the loading level problem. In general, 48 to 50 in. is most satisfactory for heavy-duty units, while slightly lower docks are more convenient for lighter equipment.

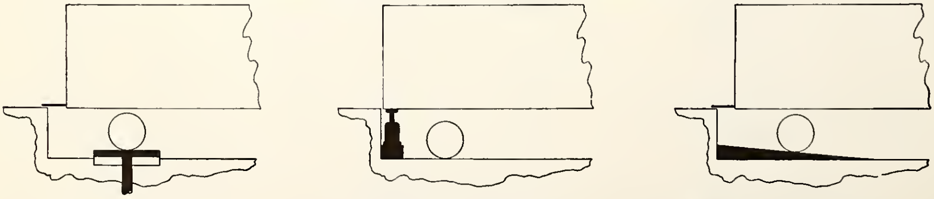
If the dock and trailer-bed levels are not equal, it is usually more satisfactory to have the dock level lower than the trailer-bed. This will permit opening and closing of trailer doors while in loading position. Except in rare cases, a slight difference in level between trailer and dock is of no great concern although a larger difference is often a handicap. Many ingenious methods have been devised to overcome such a difference and a large percentage of these have succeeded in solving the specific or general problems involved. Some of these methods are illustrated below.

Another factor to be considered is the lower bed-level of the light truck. If an appreciable part of your freight is handled by such trucks, because of short hauls, local delivery, or small loads, it may be advisable to provide docks to accommodate them.



Turning clearance for inside driveway

Methods used to overcome differences in loading level



Plunger-type elevator

Manual or power-operated jack

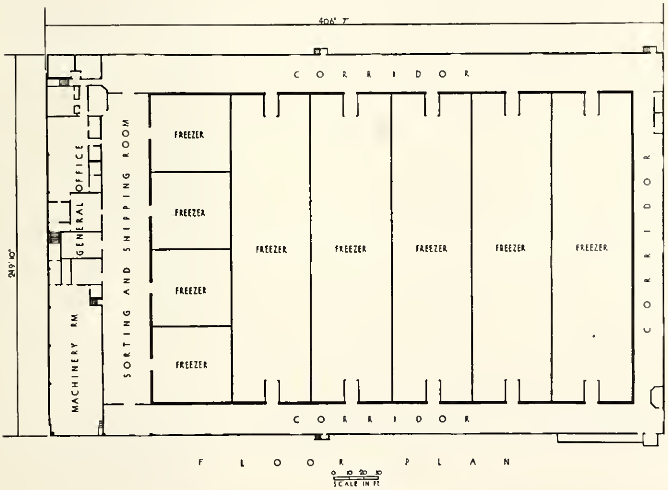
Permanent or movable incline

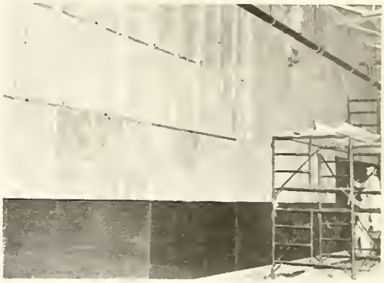
REFRIGERATED WAREHOUSE FOR FROZEN FOODS

Mid-South Refrigerated Warehouse Company, Memphis, Tenn.

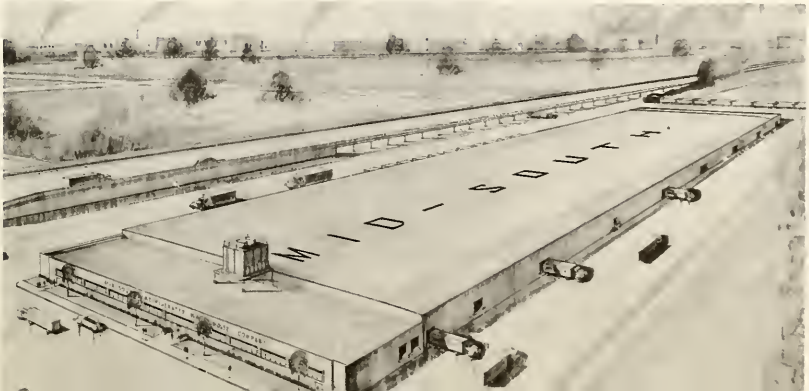
A. Epstein and Sons, Inc., Architects and Engineers

THIS IS ONE of seven huge refrigerated warehouses done by this firm of architects, in a rapid expansion of cold storage facilities that is fairly general over the country. This one covers two and a half acres, cost $2,000,000. It contains 1,300,000 cu ft of freezer capacity, at temperatures down to minus 20 deg. Roof construction is structural steel beams, long-span bar joists and precast concrete slabs. Enclosing walls, both exterior and interior, are tilt-up reinforced concrete 6 in. thick. A dry-wall method of insulation was employed throughout. The concrete tilt-up walls were prepared with a vapor barrier of laminated foil paper sprayed with asphaltic cement with all laps brush-sealed. Then followed a layer of fiber glass insulation between horizontal girts or walers, with a kraft paper convection barrier at each horizontal joint. A second layer was then installed level with blocking to receive outer studs. Then vertical studs were attached to the walers, and a third layer of insulation added between studs. Then a layer of $\frac{1}{8}$-in. hardboard completed the inner side. Walls then have 8 in. of fiber glass insulation, with vapor barrier on the outside: 10 in. of insulation on the ceiling.





Building is group of huge deep-freeze rooms surrounded by corridors and loading docks. A nice problem was to keep floors from heaving due to frost formation in sub-soil. A grid of vitrified tile, acting as air ducts, was installed under heavily insulated concrete floor. Thermocouples show when temperature drops to freezing, when heated air is introduced into the ducts



LIGHT INDUSTRY

Hugh Robertson A.R.P.S.—Panda

MODERN LUMBER YARD

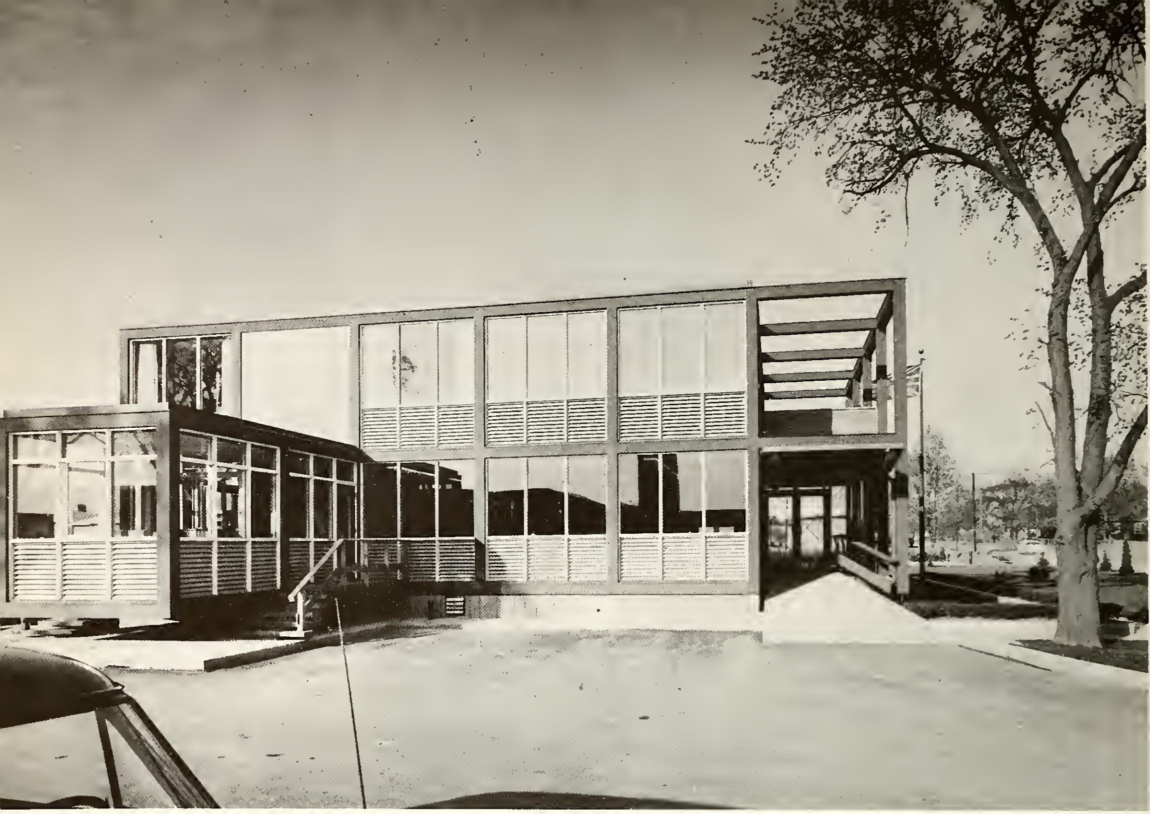
Offices, Warehouse and Factory for
The R. Laidlaw Lumber Co., Ltd., Weston, Ontario
Pentland & Baker, Architects
The Rankin Company, Ltd., Industrial Engineers; Wallace Carruthers & Associates, Structural Engineers; Leah, Koyabashi & Associates, Mechanical and Electrical Engineers; Donington-Grubb & Stensson, Landscape Architects

It is not exactly customary for a lumber yard to feel the need for the services of architects but it might be a good idea, as witness what happened in this instance. The power of the photograph herewith might suggest that the architects' efforts focused on designing a handsome office building, but that isn't true — the architects were just as heavily involved in functional aspects of the whole operation. They were responsible not only for arriving at the relationships between processes, but, together with the client's staff, for arriving at the individual process layouts of each department, and for preparing the process flow sheets in all manufacturing operations.

The new plant (it is a factory, not just a "yard") was a from-scratch assignment. The establishment began in 1871 and its buildings had just sort of accumulated ever since. Its problems had accumulated also, problems of loading, trucking, materials handling, processing, not forgetting disposing of the shavings. A new location was indicated, and a completely new plant. Hence the long and intensive study that ensued. Architects and clients visited some 50 of the most progressive manufacturing lumber yards.

It is fitting to report that the architects evidently became intensely interested in the study, for their reports about the buildings deal almost exclusively with matters of materials handling, millwork and manufacturing process layouts, fire protection, costs, and so on. And, oh yes, the owners did want the buildings, especially the offices, to do credit to the products sold.

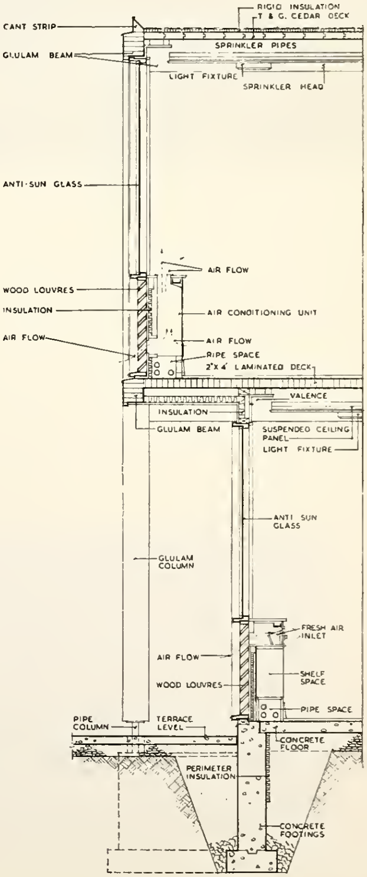
Panda

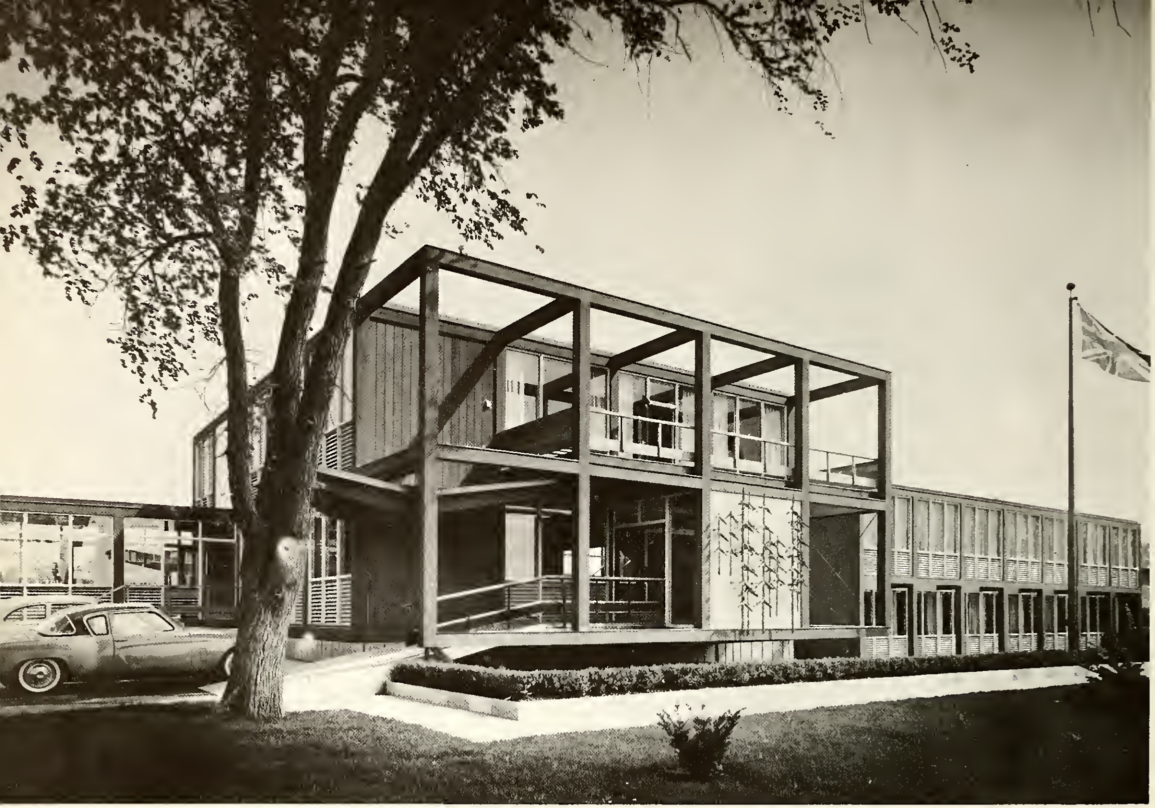


As for matters of appearance, "it was the owner's wish [to use the architects' words] that the plant be economical in cost and contemporary in design, emphasizing the potential uses of wood, both as a finish and as a structure. The entire plant was to be a showroom of those products sold and manufactured by the company, but at the same time no special matching or selection of materials other than those readily obtainable from stock was permitted."

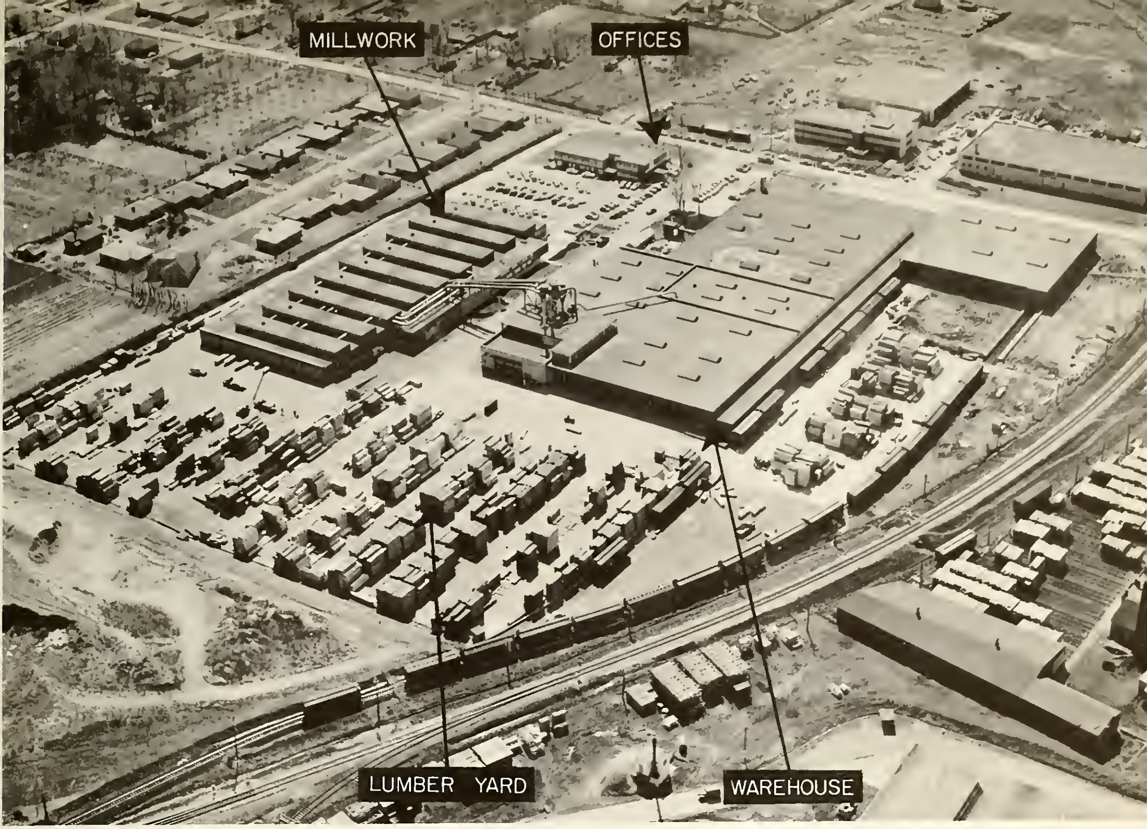
The result is architecturally and philosophically interesting. The clean, disciplined rectangles and the stark exposed framing of this design are those that today one associates more naturally with metal construction. Here it is executed in wood and timber. Surely this is not a twist, for the wood looks perfectly natural in this use. Can it be that this is a full-circle story, returning wood to an earlier dignity?

Hugh Robertson—Panda





Exterior walls of all warehouses and storage building, planing mill and millwork factory, are 3-in. tongue and groove Western Canadian Cedar, as are some exterior walls of the office building. Structural framework throughout is glue-laminated beam and post, excepting for clerestory in the planing mill and millwork factory, which are wood trusses. Roof decking is the same 3-in. Cedar, with some insulation in office and manufacturing buildings, with bonded felt and gravel covering. Finished floors in office building are hardwood or wood block over mill sub-flooring. The office building is air conditioned, and all windows are fixed with opening louvers which have been built into the cabinets containing heating and air conditioning units under windows.

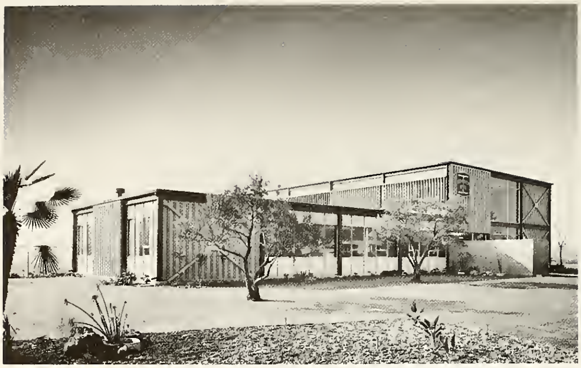


Eric Trussler, KenBell Photography Ltd.

Panda Photography

Hugh Robertson A.R.P.S.—Panda

Julius Shulman



STEEL EXHIBIT PROJECT

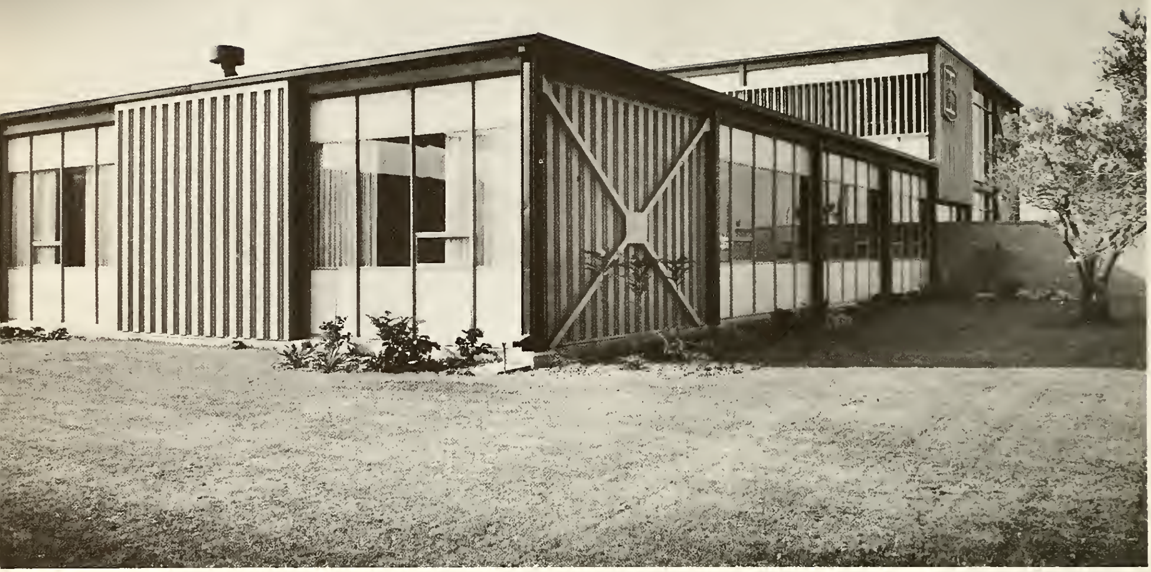
Office Building for Bethlehem Pacific Coast Steel Corp.
Torrance, California
Albert C. Martin & Associates, Architects and Engineers
Chancy M. Lott, Project Architect in Charge
Arnold Dutton, Landscape Architect

If an architect can make a sizable contribution to a lumber yard (page 86), how about a steel fabricating yard? Here the story develops a bit differently, if it does arrive at roughly the same point. Here it was the architect who suggested that the building might serve to demonstrate new and untried uses for the product sold, in this case steel. The client quickly enthused, and pleasure was had by all in the ensuing collaboration.

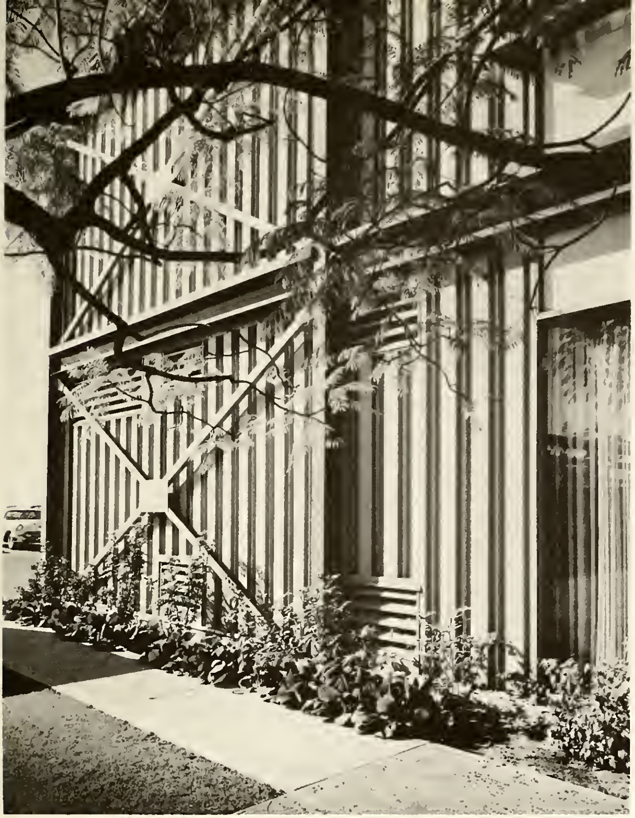
"This is the first building of its type," says the architect, "to have the structural steel supporting frames exposed. Weatherproofing and placement of the curtain wall played an important part in the design. Wherever there is angle bracing on the exterior, fluted paneling is carried immediately behind it for best effect. This fluted paneling continues inside; in fact, if the building were turned inside out the appearance of the walls would not differ radically (except that certain interior panels are special).

"The roof of the structure is built up over steel decking; the second floor slab is poured onto steel decking, and doors, partitions and paneling all are of steel. No wood is used.

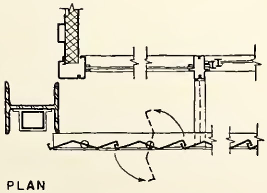
"With the completion of the building, an analysis of costs clearly indicated that steel can be as economical as it is structurally and esthetically effective. It was possible to keep within the $15.00 per square foot cost limitation, yet apply steel in many heretofore unthought of applications." Such was the architects' enthusiasm for an interesting assignment.



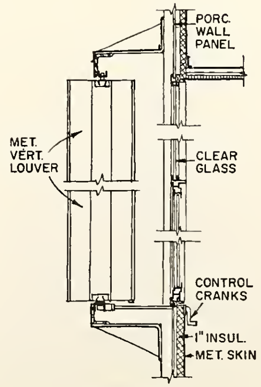
The architect comments also that the use of color is closely related to the steel industry. He began with the red lead effect of steel which he used for the X bracings. As background for the vivid red a variety of grays was used, with light gray behind the cross bracing, charcoal in columns and beams, pale gray on the porcelain enamel. The exterior grays are carried through to the interior, and new colors — yellows, greens, tans, corals — are added. The desire was to achieve a pleasant background that would best meet functional aspects of color use.



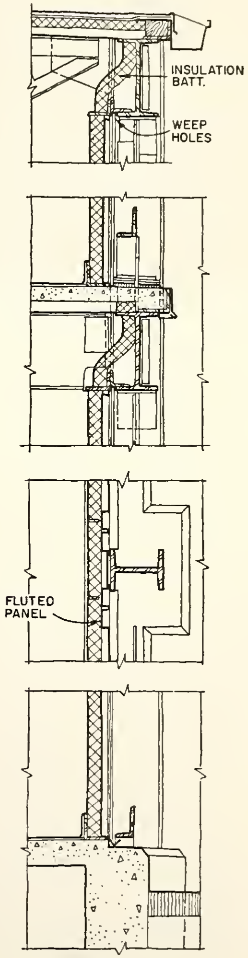
Julius Shulman



PLAN



SECTION

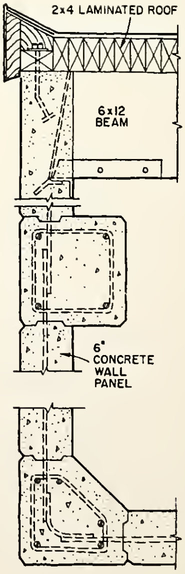


FLUTED WALL DETAILS

EMPLOYES COME FIRST

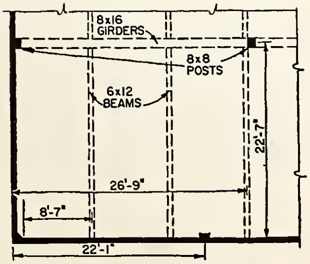
Factory and Offices for Oregon Saw Chain Company
Portland, Oregon
Van Evera Bailey, Architect
Robert E. Kremers, Structural Engineer; J. Donald Kroeker & Associates, Mechanical Engineers; Fritz Klawa, Electrical Engineer; Chandler Fairbank, Landscape Architect

This factory for saw chains follows progressive thought in many respects. Perhaps most notable is the evident consideration for workers. The two pictures above show the employes' entrance, not the visitors' entrance, and the employes' lobby, the stairs leading to the cafeteria. For another thing, it follows the idea of locating the plant out in generally residential surroundings, with pleasant outlook and freedom from traffic congestion. The architect comments that he worked especially to achieve the lowest insurance rate, and managed that not-easy feat. Lowest rate was important in a factory doing much heat treatment. Observers comment that this is one tilt-up wall job that looks as if an architect designed it; both wall panels and columns are precast concrete, set in place with cranes. Otherwise the building is of mill construction, with Bailey's special laminated roof construction.



TYPICAL COLUMNS

Photo-Art Commercial Studios



PLAN

Gottscho-Schleisner Photos

PLANT FOR TEXTILE DYE AND INKS

Manufacturing Plant for Interchemical Corporation, Hawthorne, N. J.

The H. K. Ferguson Company, Industrial Engineers and Builders

WHILE THE PROGRAM for this plant was fairly typical of clients' requests, the solution was unusual in the degree to which economy was achieved. Economical steel design, curtain walls above windows, concrete block walls, all contributed important savings.

The new plant brings together in one location some textile dye and ink processes previously in scattered plants. There are seven buildings in all, all but one of single-story height, occupying a site 960 by 1000 ft along the Passaic River.

In the design of the steel frame the engineers took all possible advantage of the principle of cantilever. They also used a lightweight, welded steel roof deck. Purlins are welded to roof members, and the wind load is thus transmitted through the roof to all columns. Altogether, the design cuts the weight of steel substantially in comparison with conventional design. The weight saving was sufficient to permit the use of pipe columns in place of structural steel shapes and to keep the footings smaller than would be necessary for more orthodox steel design.

The typical wall design is such as to produce savings both in cost of materials and in erection time. Masonry work and framing both were held down by using brick masonry only below the windows, with corrugated aluminum siding above, thus retaining the advantages of masonry below the windows. Structural columns are recessed several inches from the outside wall to permit

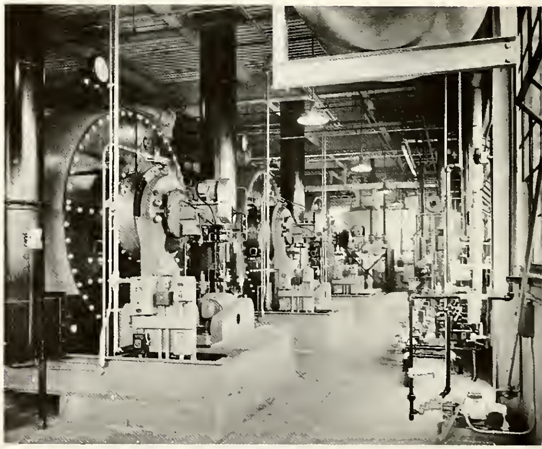
Gottscho Schleisner Photos

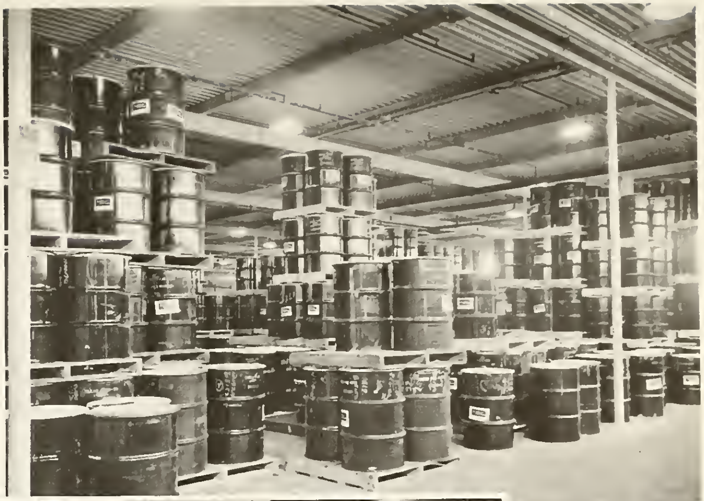
continuous sash. The result is an attractive wall, erected quickly at low cost.

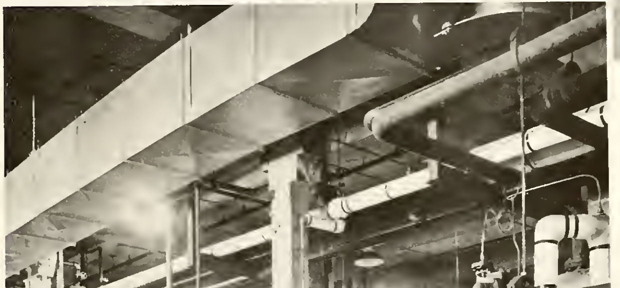
Buildings not facing directly on the highway have concrete block walls, a band of continuous sash, and aluminum siding above, again for weight savings, ease of erection and low cost. The one four-story pulverizing building uses aluminum siding for all except the ground floor, placing reliance on the reflective insulating value of the bright surface to prevent heat losses from becoming excessive.

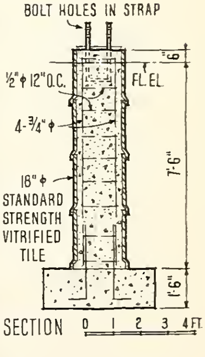
In the dye plant, where acid fumes are given off in the chemical reaction, wood columns are used instead of the steel pipe columns, because of the corrosive action of the acid used. Footings under these columns are enclosed with glazed drainage tile to protect the concrete and reinforcing steel from acid seeping into the ground (detail page 101). A rather incidental economy measure was the dual use of drainage tile as a fume exhaust for heavy gases as well as drain. Fans at a remote point maintain a suction at the drain opening, and also carry fumes from the drain tile into a stack.

The site was chosen to provide plenty of expansion room, and each individual building was planned to permit addition without serious disturbance; in fact some have demountable end walls ready for removal.

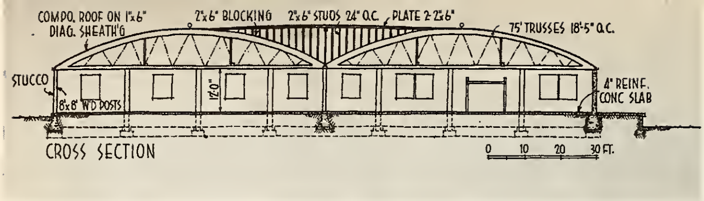








In most of the buildings the structural system uses simple steel pipe columns (upper photo); in the dye plant wood columns are used instead, because of corrosive action of acids used (lower photo). Footings are enclosed with glazed tile to protect concrete and reinforcing steel against acid seeping into the ground (detail, right)



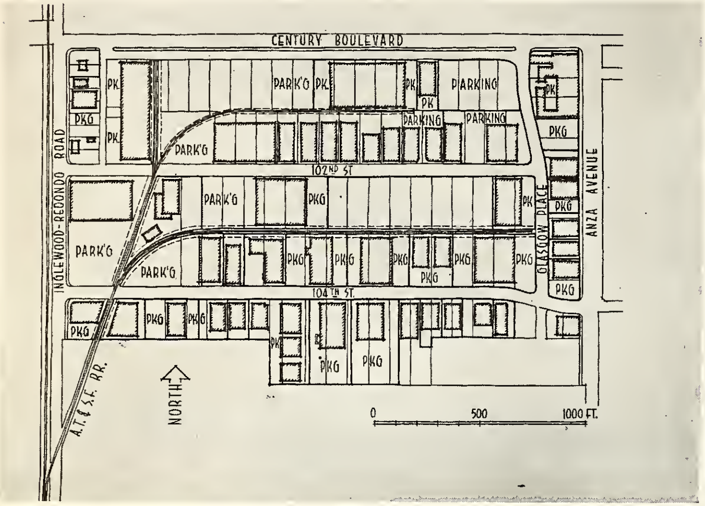


Photo: William Eccles

TILT-UP BUILDING FOR INDUSTRIAL

International Airport Industrial District, Los Angeles

S. Charles Lee, Architect

The industrial subdivision, or "district," is by no means a new idea, but is one that has seen much development in the postwar industrial expansion. The advantages of prearranged rail lines, roads, utilities have been attractive to small factories. Frequently, in fact usually, there have been further advantages of efficient and economical construction, so that many of the factory management's building problems have been solved for them by specialists of the district.

The International Airport Industrial District at Los Angeles is one that grew rapidly. Its 95-acre site was developed by Samuel Hayden and S. Charles Lee, architect, with Frank A. Schilling as project manager. There are 120 plots, each slightly over a half acre, zoned for M-2 light industrial buildings. There are certain controls over plans, set-backs, parking provisions, and so on, so that there are guarantees of continued smooth operation.

Virtually all of the buildings use the Precastructural system of tilt-up concrete construction, with methods and modules standardized. The standard spacing of trusses, based on the maximum allowable length of 2 by 8 rafters spaced 24 in. o.c., automatically establishes a modular length of side wall panels for 18 ft 5 in. bays. An early fault of some precast wall panels — shrinkage cracks at corners of window and door openings — was eliminated by the use of diagonal steel in the panels.

The standard practice on the Hayden-Lee tract has been first to prepare the grade for the floor, whether it be ground level or car height. The isolated footings on which the wall panels rest are then poured, then a strip of floor of suitable width is laid in checkerboard pattern to control cracks. Next the floor is coated with a bond-breaking agent — and simple wall forms are placed on the slab in a horizontal position. Steel sash, held in forms, are then placed, followed by reinforcing steel, and the concrete poured. After the required curing time has elapsed, the wall panels, weighing up to 30 tons, are raised by heavy truck cranes or derricks, placed in vertical position and braced by means of adjustable braces. Column steel and enclosing forms are erected and the columns poured, after which the trusses, which have been built and assembled on the job, are raised, and the roof completed.

Typical arched truss spans 75 ft, and typical building combines units of space that are 18 ft 5 in. by 75 ft. Usually about 10 per cent is devoted to office space, and fronts are given treatment to suit the client.

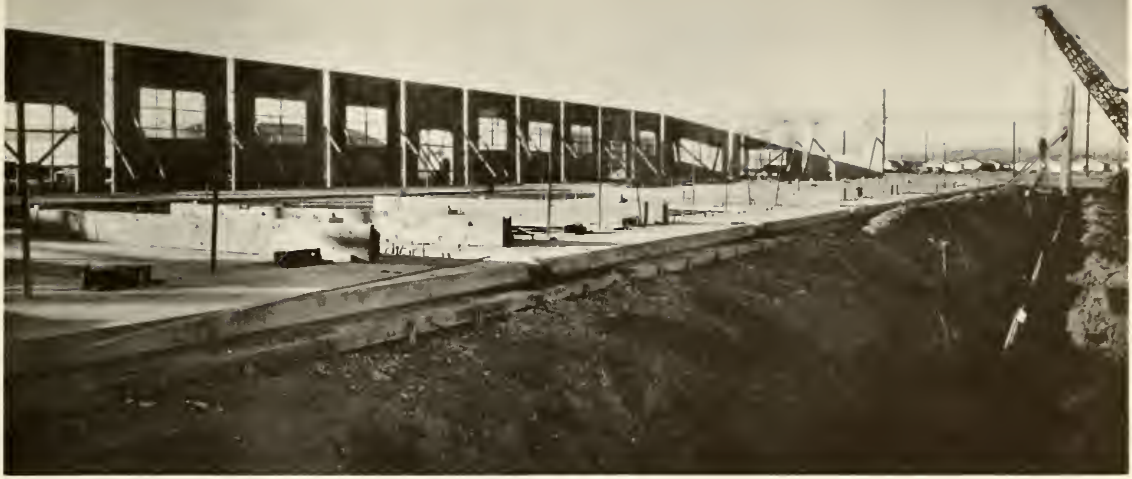
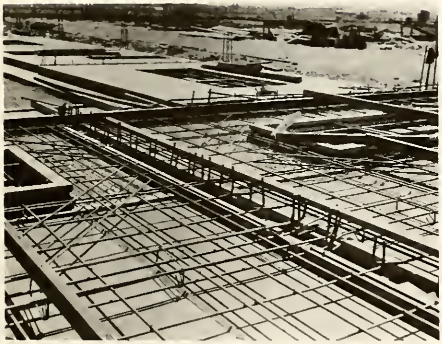
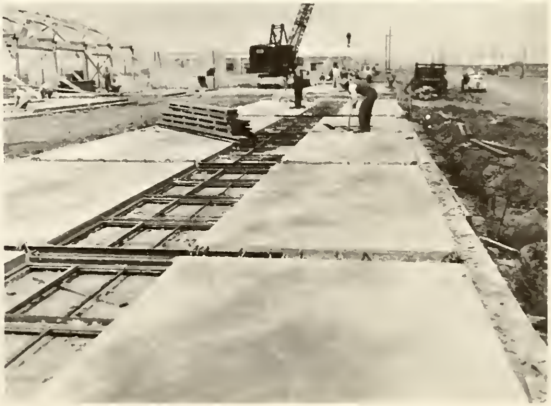


Photo: Julius Shulman

DISTRICT

Samuel Hayden, Builder

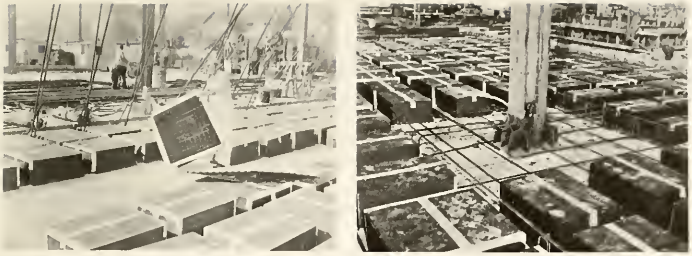




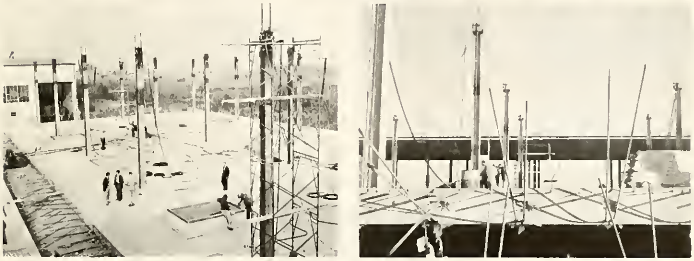
Various stages in the tilt-up process in which side wall panels are poured on the floor, raised into position and joined by poured columns. Wall panels are dimensioned to fit an 18 ft 5 in. column spacing, usually are 12 ft high. Roof trusses, 75 ft, are built on site

Most plants at International Airport Industrial District are small factories, making small products or parts — plastics, food products, sheet metal products, electronics, cosmetics, and so on. Buildings look much alike except for the fronts, where trademarks and promotional displays show strongly as the determinant for esthetics

Photos: Julius Shulman



Fibre board boxes, shown during assembly and after placing, give "waffle" shape to slab, eliminate expensive wood forms and bracing



Slab was poured and raised in three sections. Center slab, the largest ever raised, weighs 1400 tons, and has an area of 32,600 sq ft

LARGEST, HEAVIEST LIFT SLAB POURED FOR NEW JERSEY PLANT

The first lift slab roof structure to be raised in the metropolitan New York area has set a record as the heaviest and highest clear span concrete roof slab ever to be lifted. A relatively new method for industrial buildings, the lift slab technique has made possible a 1466-ton concrete roof with an area of 32,600 sq ft for the Standard Tool & Manufacturing Company in Lyndhurst, N. J. Two other roof sections of the new plant each weigh 1020 tons and measure 22,400 sq ft in area.

New York architects Powers & Kessler, who designed the building, claim that it is unique in many ways. Not only is it the heaviest lift slab ever raised, but also it is supported on columns spaced on 40-ft centers instead of standard 24-ft centers, thus affording much more open area for production lines, and it has a clear height of 26 ft 5 in. above the floor instead of standard heights of from 8 to 15 ft. The lower costs resulting from this construction system, according to structural engineers Garfinkel & Marenberg of New York, provided a large-span fireproof building for about the same cost as a nonfireproof structure built by standard construction methods. This record was achieved not just by eliminating expensive concrete wood forms and bracing but also by keeping the quantities of concrete and reinforcing steel used within economical limits and by restricting the loads lifted at each column to the rated capacity of the lifting equipment.

The slab itself is a "waffle" shape, with a total depth of 16 in. and a "waffle" depth of 13 in. The waffle shape was attained by using corrugated cardboard boxes as fillers The waterproof boxes, braced with honeycombed cardboard partitions to prevent deformation due to the weight of the set concrete and other · construction loads, were 34 by 34 by 13 in., although they can be manufactured to any size desired. With 6-in. ribs between boxes, a pattern of 12 ribs in each direction per column panel was created. Into this symmetrical ceiling layout was coordinated the lighting, sprinkler and monorail systems. Since there are no trusses or other obstructions in the ceiling, pipes, ducts and cranes can be run continuously in the same horizontal plane. Maintenance is reduced because of the minimum number of steel members that must be painted.

A concrete with expanded shale aggregate, which is one-third lighter than ordinary stone concrete, produced a strong slab equivalent in weight to a 6-in. slab of ordinary concrete. It not only reduced the weight of the slab but also, according to the ratings of the National Board of Fire Underwriters, doubled its fire resistance. This increase in fire resistance added another economy to the building in the nature of added usable space. The amount of setback required on all sides of the building as a fire separation precaution was less than would have been necessary with the next most effective noncombustible type of construction and so permitted the addition of 10,000 sq ft of plant area.

The design strength of the concrete was 3000 psi, although test cylinders indicated the actual strength to be as high as 5000. The weight of reinforcing steel in the slab came to 6 psf.

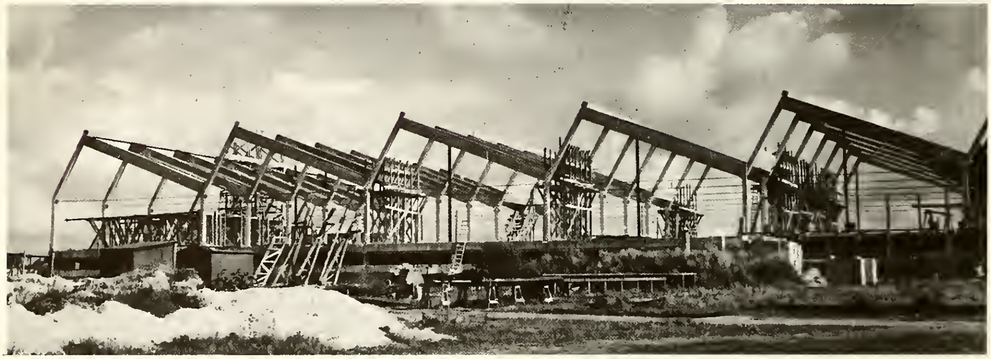
Hydraulic jacks on top of the 24 wide-flange steel columns lifted the massive concrete roof. The two smaller roof sections were lifted separately, with a gap of approximately 9 in. between each of the three sections. After all three slabs had been raised, concrete was poured into the gaps.

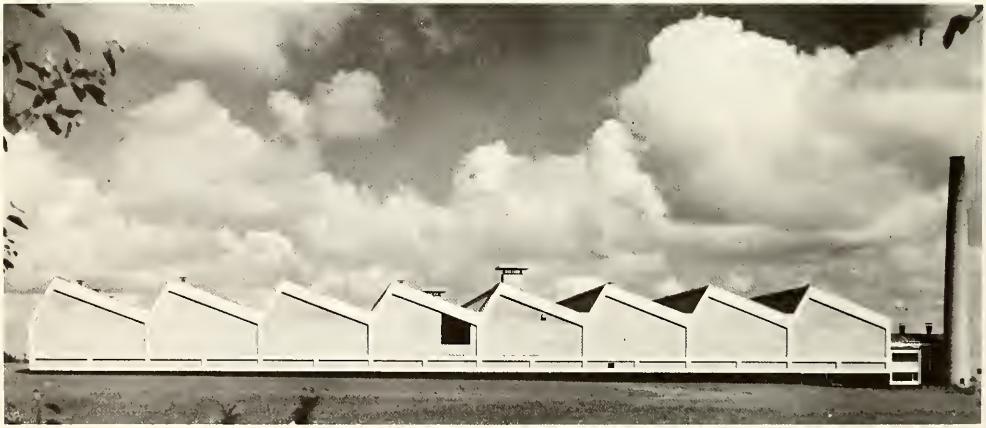
The architects are now working on still more advanced ideas of cost saving and flexibility in fireproof structures — including more functional use of cast-in-place slabs, reduction of work in other trades after the slab is lifted, new methods of hanging and supports for piping, new means of including insulation in the basic slab, and using the mass effect of the structure for summer cooling.

THREE CONCRETE STRUCTURES IN DENMARK

Examples showing application of precast concrete and some prestressing give an idea of the trim lines possible and point up the contrast between European and U. S. construction methods

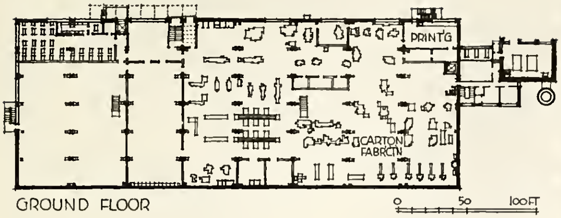
Sign, clock, fence and marquee at the Obel packaging plant are typical of the neat design seen at some new Danish factories





Concrete framing of the Obel plant expresses itself in the exterior design. The narrow strip along the bottom indicates the service space for water and air pipes and electrical lines. Column bents and rafters (heaviest pieces) are precast, but gutter section was poured in place. Bents are not stable by themselves, and tie rods hold framing together

Preben Hansen, Architect



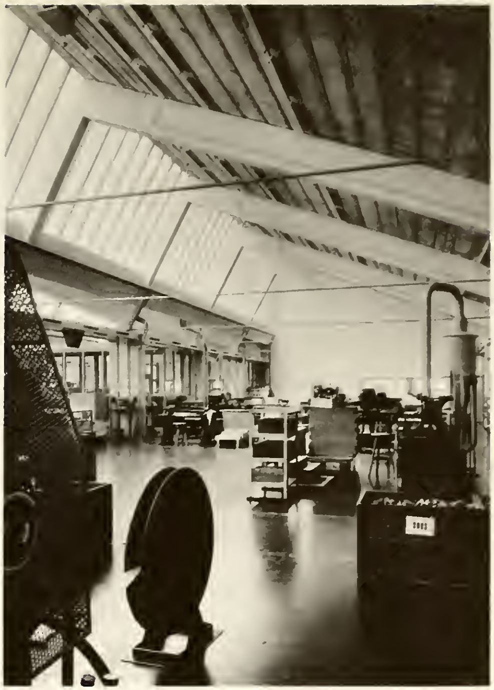
CONCRETE has long been a favorite building material in European countries, and for some years now, efforts have been directed toward the development of precast building units — in many cases prestressed to lighten them — in order to speed up construction time and to permit work to start as soon as plans are finished. This avoids unnecessary stoppage or delay of work and also reduces the loss of return on the capital invested in site and buildings.

The three buildings here show some recent work of this nature in Denmark and demonstrate what openness of space and light feeling can be accomplished with precast and prestressed concrete.

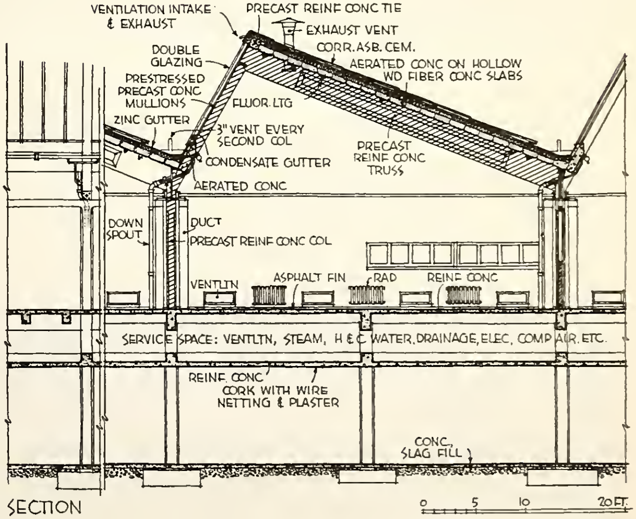
Perhaps more significantly, though, these examples point up graphically the differences between the more mechanized construction methods of the United States as contrasted with those abroad and the consequent effect on the design of the structural system.

For example, instead of being able to bring in huge movable cranes, capable of hoisting heavy rigid frames of concrete as is common practice here, it was necessary in one of these Danish buildings to construct a total of seven erection towers of wood, taller than the building itself, to hoist up the precast rafters for eight bays. And in another, a movable erection bridge (a sort of traveling crane) was built to span between the cast-in-place gutters and columns, with rails in the gutters for the bridge to travel on.

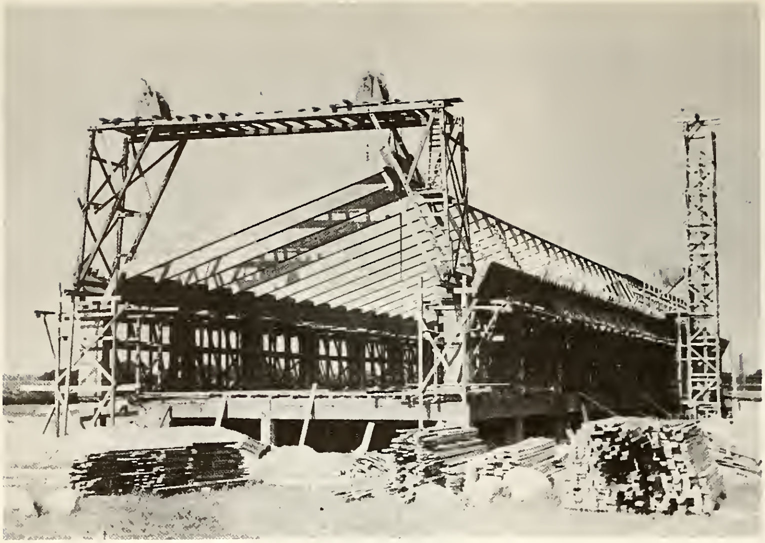
These limitations, of course, determined the size of precast members that could be handled and must have had a great deal to do with the actual structural design.



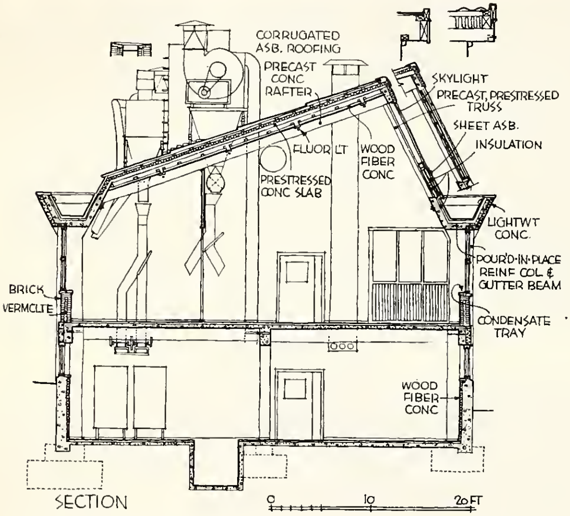
Mullions of the skylight are thin strips of prestressed concrete. Natural light is supplemented by fluorescent lamps mounted on the ceiling. Note how the air conditioning ducts rise up on either side of the column bents and then run horizontally between them



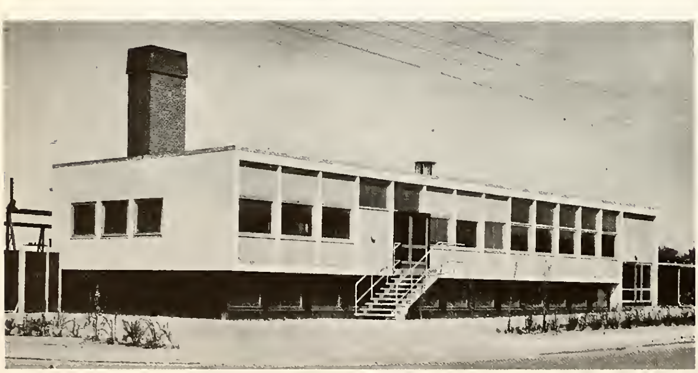
Shading covers the two main precast elements of the frame. Heavy gutter unit was cast in place



In building the cigarette factory, the columns and the gutters which carry the load of the rafters to the columns were cast in place. The rafters and skylight posts were hoisted into position by this traveling crane which ran on tracks in the gutters. Hoist worked by hand



Below. thin structural mullions are prestressed concrete, and give this office and canteen building a delicate appearance



Carton Manufacturing Plant

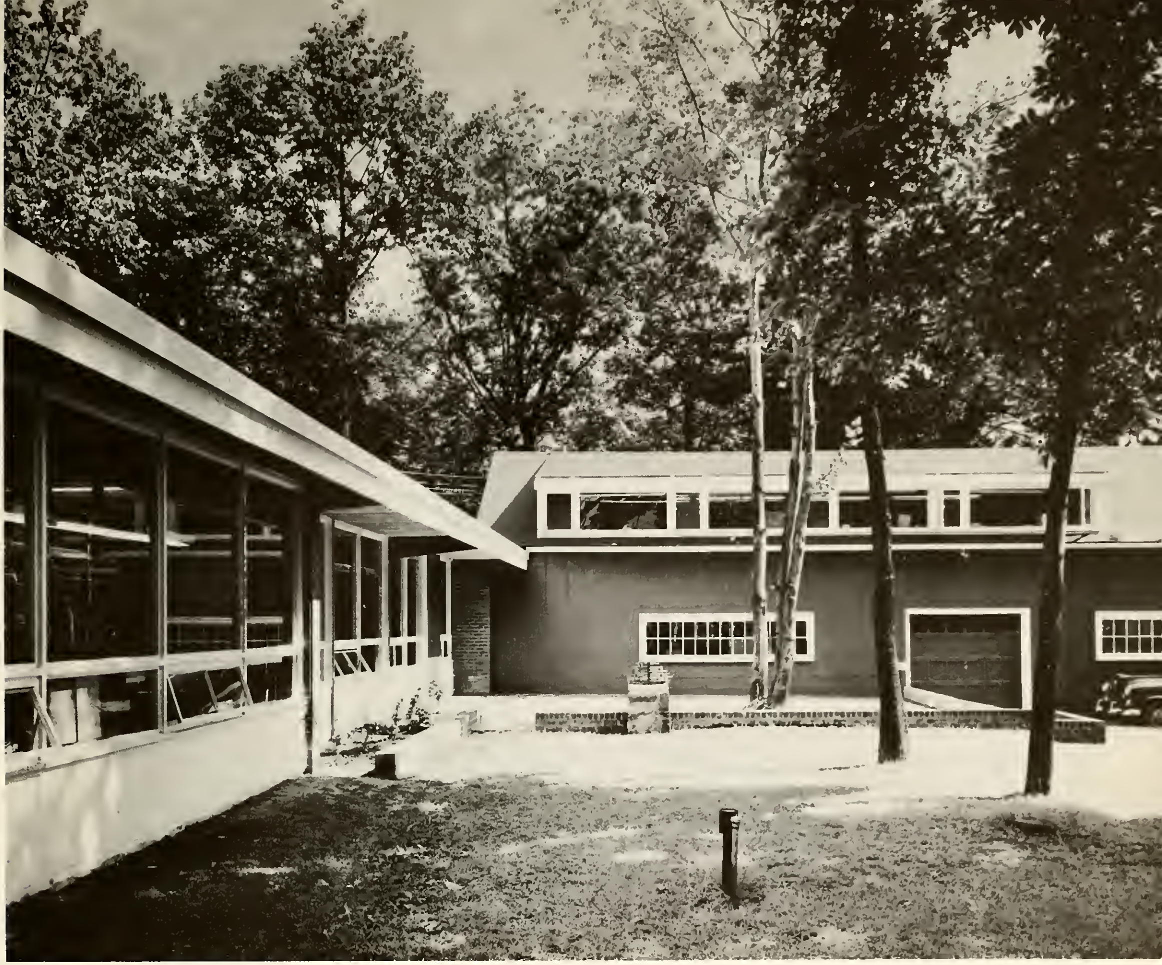
This saw-tooth skylight factory of 12,000 sq ft, with column spacing 20 by 40 ft, employed three types of precast units: a column bent, 1 ft sq and weighing 3750 lb; a rafter 34 ft long, 12 by 29 in., weighing 12,000 lb; and a ridge beam 20 ft long, 12 by 14 in., weighing 3740 lb. As mentioned before, seven erection towers, mounted on the finished floor slab, with the operating platform above the structure, hoisted up the cured units which had been cast on the floor slab under the spot where they were to be used. Columns, the I-shaped rafters and ridge beams were raised in that order. Then the gutter, because of its size and weight, was cast in place.

The whole skeleton construction is held together by tie rods, anchored by bolts to the columns. The later expansion of the tie rods was accommodated during assembly by placing the columns slightly out of plumb, so that when the roof slabs were laid, the rods became tensioned and the columns plumb.

Cigarette Factory

Here again skylight design was used, but the columns and gutters both were cast in place, the gutters being designed to carry the load of the rafters to the columns and down to the foundation.

The concrete rafters (7½ by 20 in.) were precast on the floor slab, and both prestressed and precast mullions were employed in the skylight. The superstructure was assembled by the means of the erection bridge which had a hand winch for lifting the concrete members.



Ben Schnall

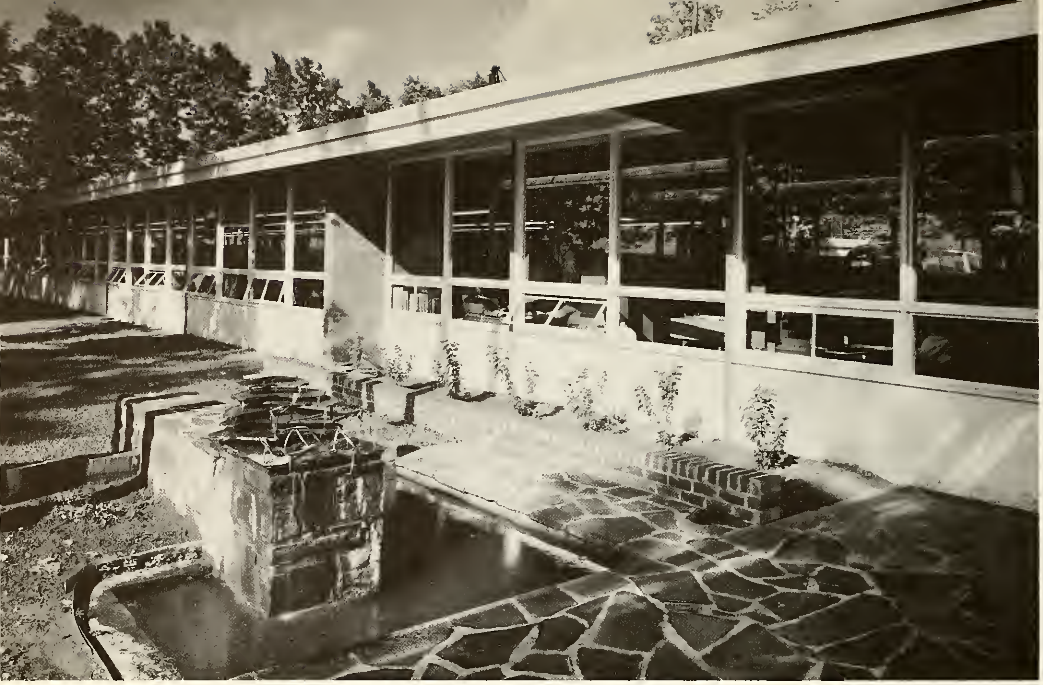
PART ONE OF A FOUR-PART FACTORY EXPANSION

Rotron Manufacturing Co., Woodstock, N. Y. — Slater & Chait, Architects

MIRRORING THE TYPICAL American success story of the small manufacturer starting in a barn and steadily expanding into larger quarters as business grows, this industrial plant is of interest for several other reasons as well.

Devoted to the manufacture of electric and electronic equipment and research, the factory is located on the summit of a mountain with an attractive south view of the surrounding Catskills. Glass areas look out to the view, providing worker amenity that has contributed much to the excellent owner-worker relationship.

The new one-story wing, placed at right angles to the barn, is composed of manufacturing and office space in a ratio of about three to one — this functional division being clearly marked in elevation by the

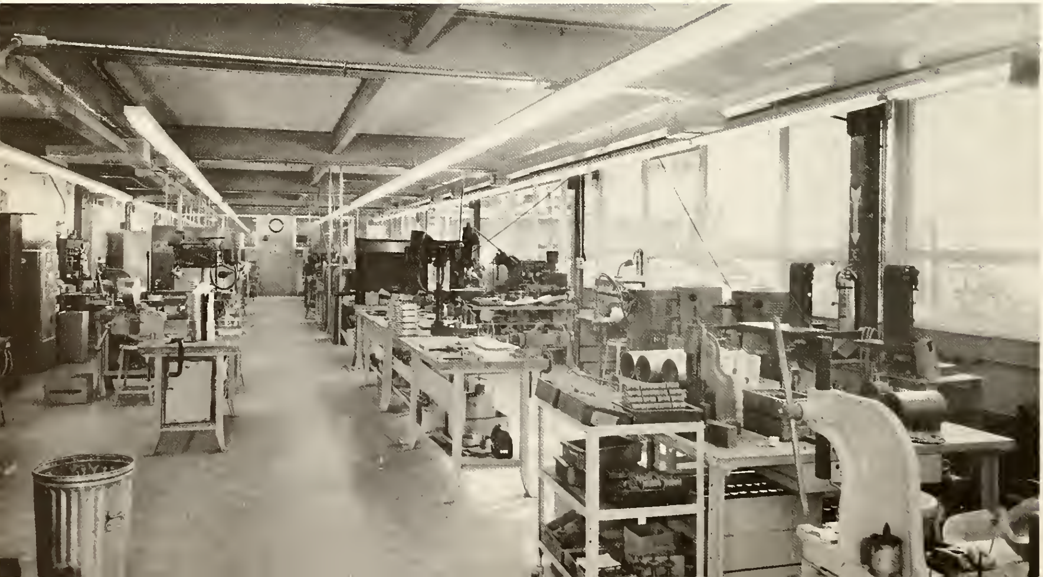


ROTRON MANUFACTURING CO., WOODSTOCK, N. Y.

brick wing-wall. Public and office entrance is located near the juncture of old and new buildings. The new second floor dormer serves the drafting room.

The 4800-sq-ft wing cost $8 per sq ft., not including electrical work. It is steel framed, with steel sash and cinder block wall panels, both painted. The roof is built up over concrete and wood-chip plank, left exposed inside.

Ben Schnall



Chicago Architectural Photographing Company

EXPANDABLE PLANT FOR GROWING FIRM

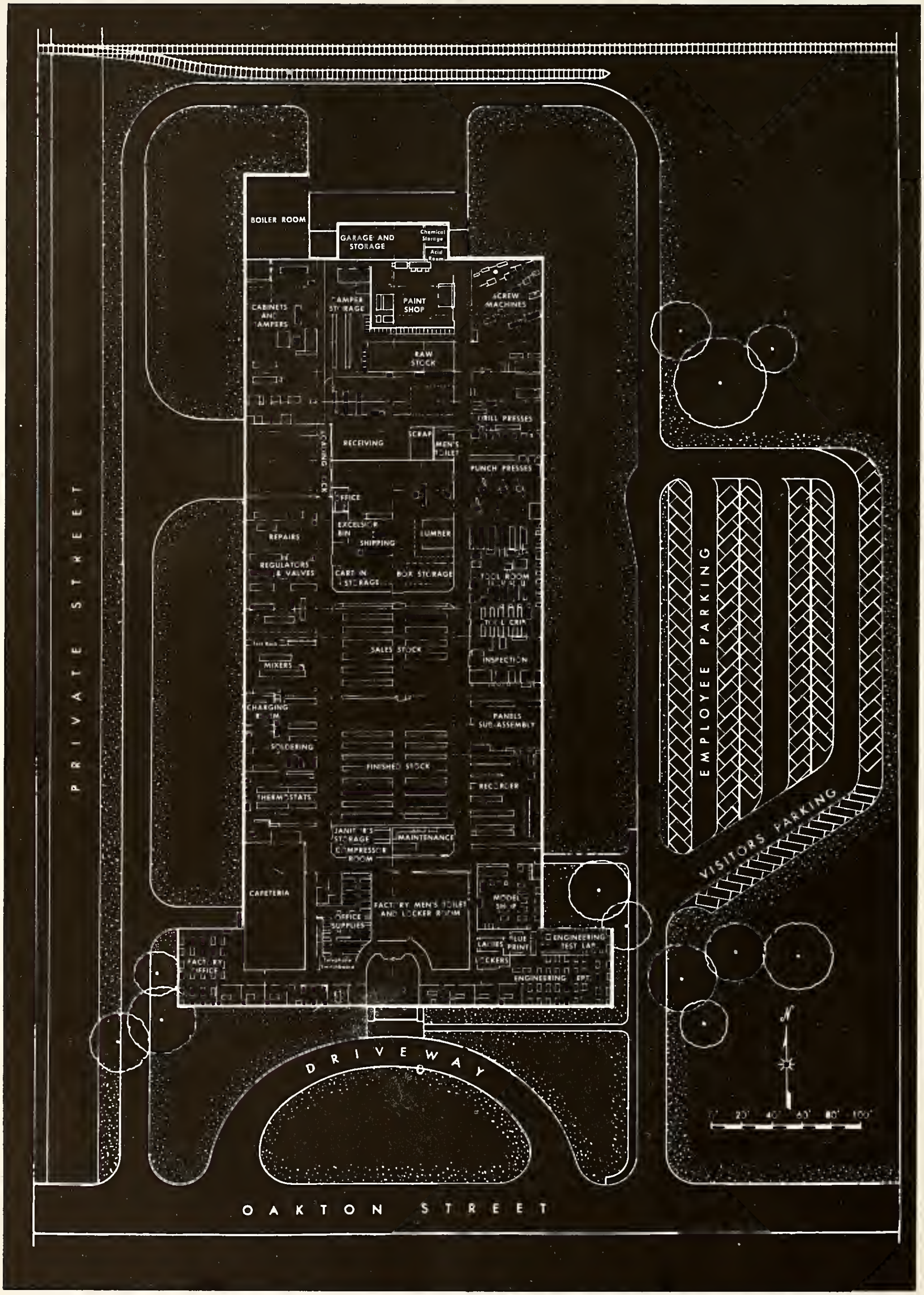
Manufacturing Unit for The Powers Regulator Company

Skokie, Illinois

Sessions Engineering Company, Architects and Engineers

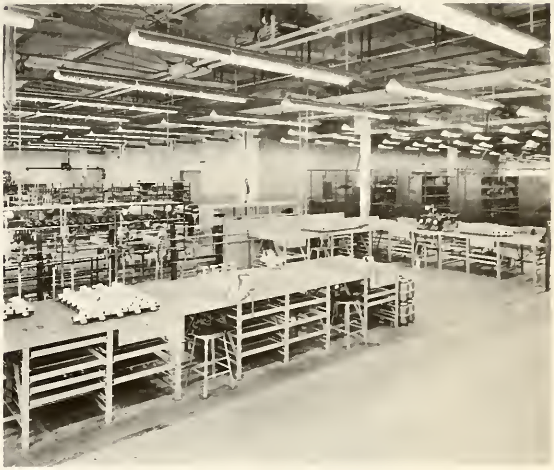
A PRIME CONSIDERATION in the design of this plant was provision for expansion. In 1940 and again in 1943 the company — manufacturers of air conditioning, heating and ventilating controls — had added materially to its facilities; a few years later both office and factory space were again insufficient.

The new plant was planned to allow relatively easy factory expansion without disturbing the office layout. The building is T-shaped, with a 290-ft-long two-story office and laboratory section across the front. The factory section is one story in height, 200 ft wide by 460 ft long. Manufacturing departments are located around the outside walls, and are fed from the storage areas in the center of the plant. Truck docks are adjacent to the shipping department and stock rooms. Work and material flow problems were studied with three-dimensional scale models of all plant equipment, placed on a large-scale floor plan; staff members could visualize their departments before the plant layout was approved, and were able to help actively in the planning.


BOILER ROOM
GARAGE AND STORAGE
Chemical Storage
Acid Room
CABINETS AND DAMPERS
DAMPER STORAGE
PAINT SHOP
SCREW MACHINES
RAW STOCK
DRILL PRESSES
LOADING DOCK
RECEIVING
SCRAP
MEN'S TOILET
PUNCH PRESSES
OFFICE
EXCELSIOR BIN
SHIPPING
LUMBER
REPAIRS
REGULATORS & VALVES
CARTON STORAGE
BOX STORAGE
TOOL ROOM
TOOL CRIB
Test Rack
SALES STOCK
MIXERS
INSPECTION
CHARGING ROOM
PANELS SUB-ASSEMBLY
SOLDERING
FINISHED STOCK
RECORDER
THERMOSTATS
JANITOR'S STORAGE
MAINTENANCE
COMPRESSOR ROOM
CAFETERIA
FACTORY MEN'S TOILET AND LOCKER ROOM
MODEL SHOP
OFFICE SUPPLIES
Telephone Switchboard
LADIES LOCKERS
BLUE PRINT
ENGINEERING TEST LAB.
FACTORY OFFICE
ENGINEERING DEPT.
PRIVATE STREET
EMPLOYEE PARKING
VISITORS PARKING
DRIVEWAY
OAKTON STREET
N
0' 20' 40' 60' 80' 100'

Welded steel construction resulted in a low steel weight per square foot of area, speeded up construction, and allowed wide, unobstructed bays. A well-insulated roof, elimination of skylights, and heat-resistant glass in all windows combined to permit reduction of the heating system by about 50 per cent. The factory section is heated with a hot water circulating system through unit heaters and radiators under all windows. The office area is completely air conditioned.

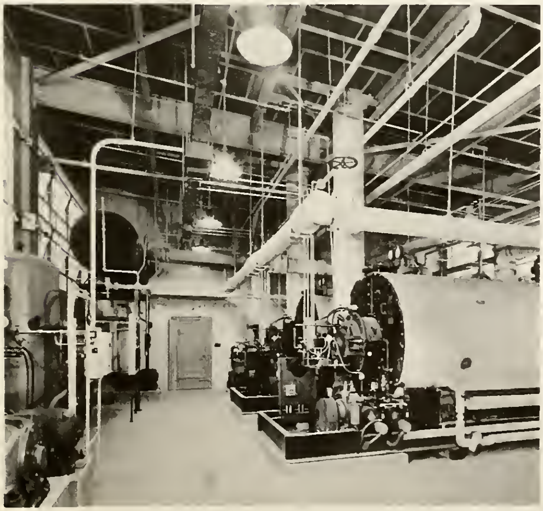
Exterior walls are buff-colored brick with limestone trim and steel sash. Floors are asphalt tile in the office section, reinforced concrete treated with iron floor hardener in the factory area. Offices and cafeteria have acoustic ceilings. Lighting throughout is fluorescent.

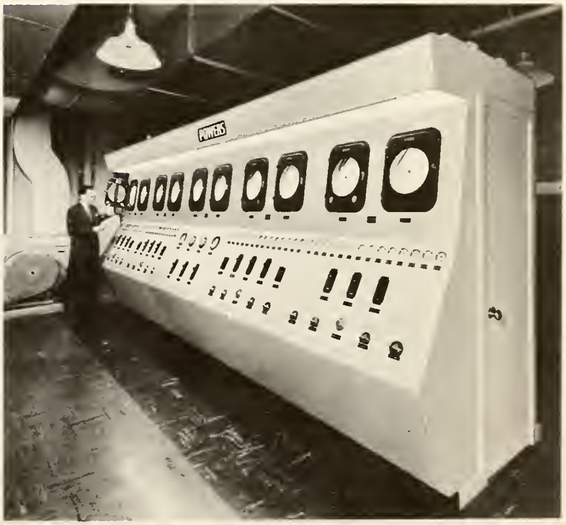


Chicago Architectural Photographing Company

Center bays (above and above right) are used for storage, shipping and painting. Aisles are 10 ft wide to accommodate fork lift trucks. An electrified monorail hoist system delivers material from receiving dock to raw stock room Entire building is sprinklered

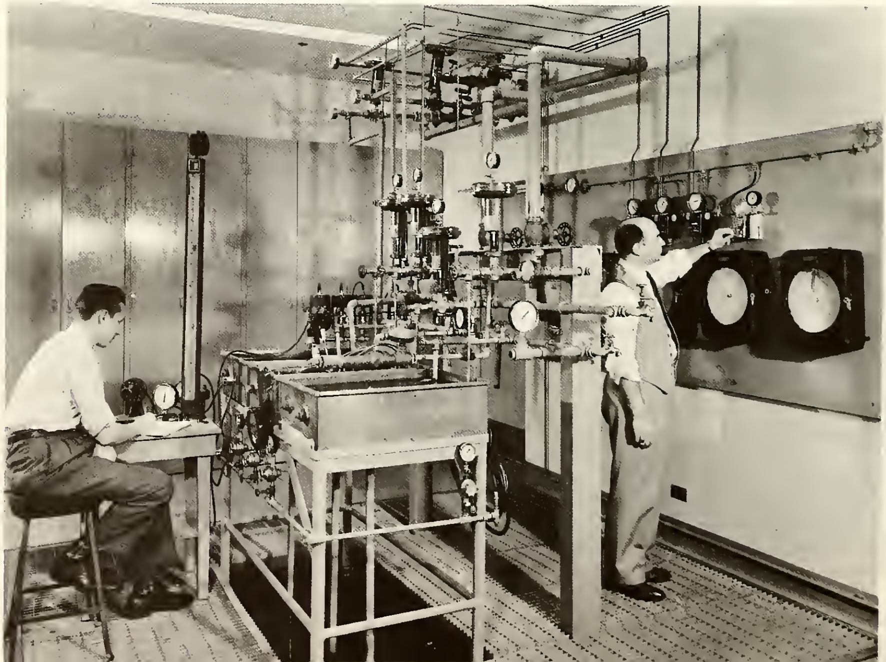
Below, left: boiler room contains two oil fired boilers; underground tanks provide oil storage capacity for three coldest months. Below, right: control panel for heating and air conditioning. Walls are glazed tile, floors asphalt tile for easy maintenance





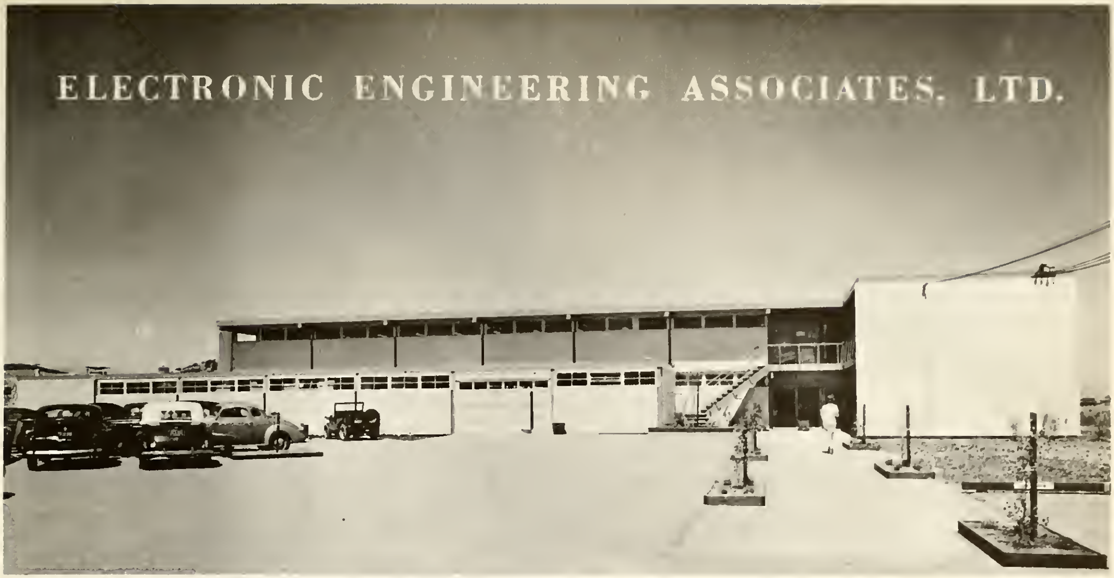
Above: left, president's office; right, employees' cafeteria seats 500, has movie screen and amplifiers

Below: testing section of research laboratory. Here as in factory, rubber matting on floor reduces noise, vibration



Chicago Architectural Photographing Company

ELECTRONIC ENGINEERING ASSOCIATES, LTD.



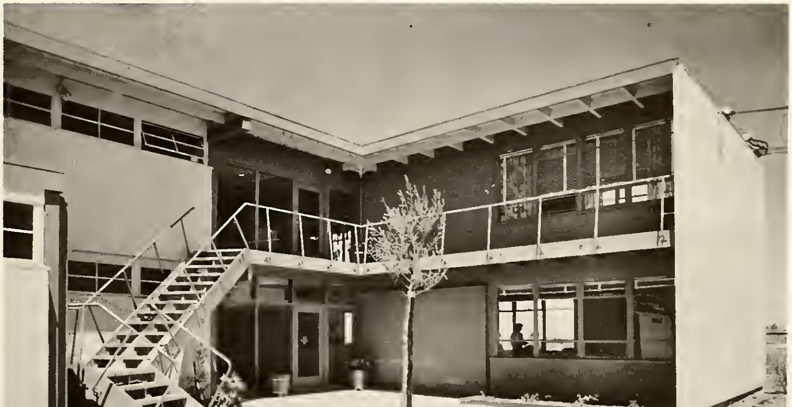
Roger Sturtevant Photos

San Carlos, California

Francis Joseph McCarthy, Architect

WINNER of second place * in the industrial class in the 1951 Honor Awards Program of the American Institute of Architects, this compact new plant houses three functionally separate but mutually interdependent organizations: Sierra Electronics Corporation, developers of electronic equipment; Sierra Manufacturing Company, the manufacturing group; and Electronic Engineering Associates, Ltd., the merchandisers and owners of the building. It was planned as the basic unit of a much larger plant, and eventually will be used solely by the development and merchandising groups. The second unit will be for the manufacturing group.

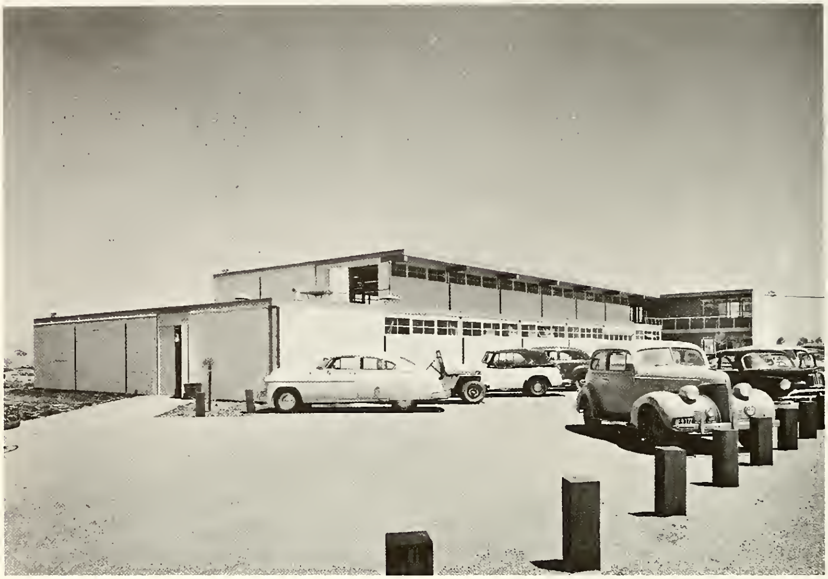
At the present moment, the development company occupies the entire ground floor (page 117). Offices



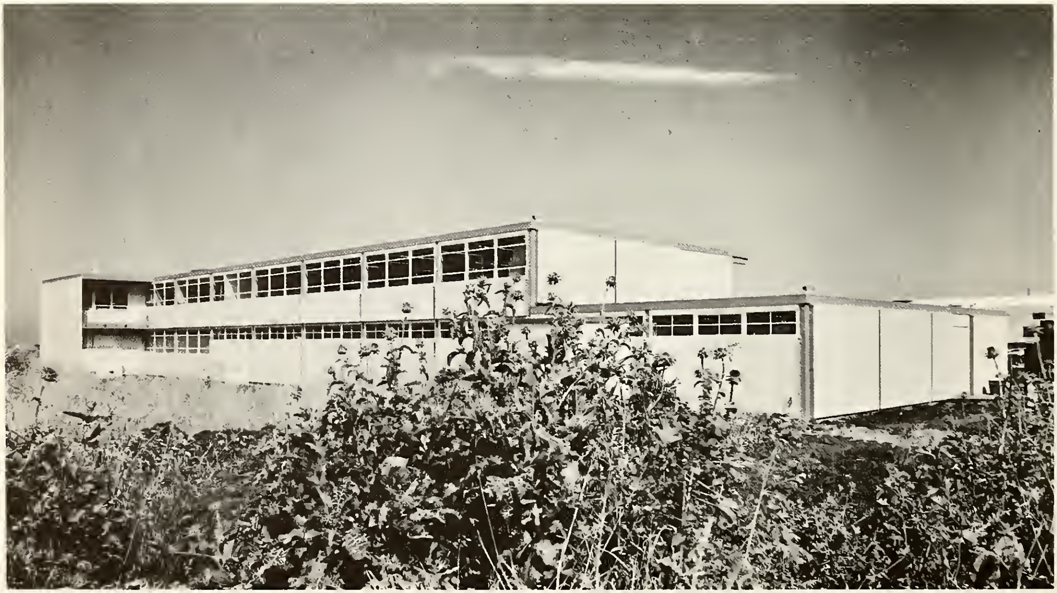
**First place was won by the Houston Coca-Cola Bottling Company, Stone & Pitts, Architects and Engineers (see pages 132–139).*

ELECTRONIC ENGINEERING ASSOCIATES, LTD.

A. V. Saph, Jr., Structural Engineer
G. M. Simonson, Mechanical Engineer
Douglas Baylis, Landscape Architect
Baker Construction Company, Contractor



Roger Sturtevant Photos

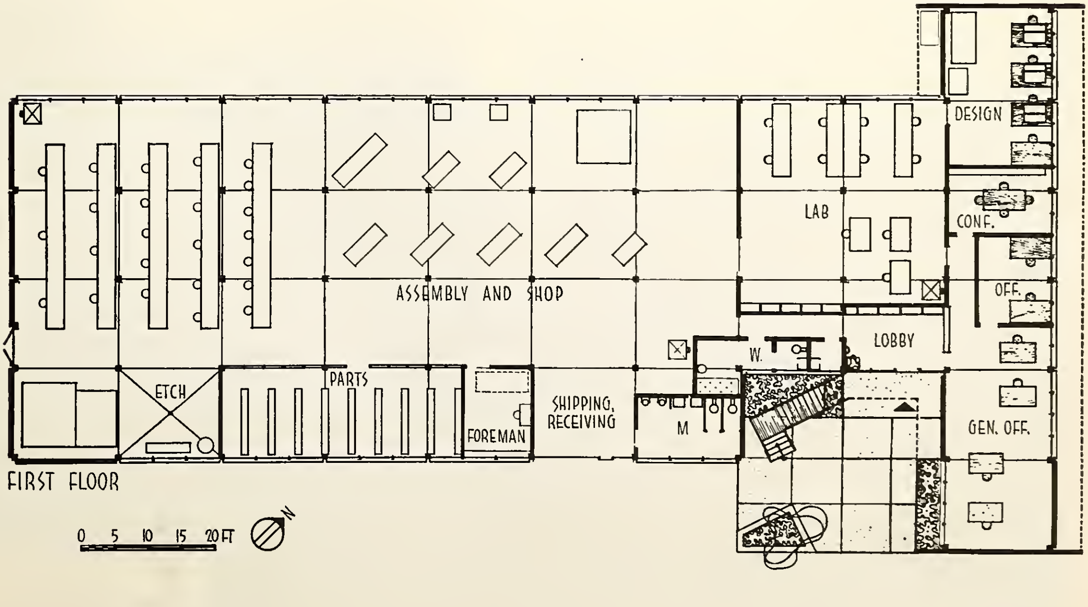


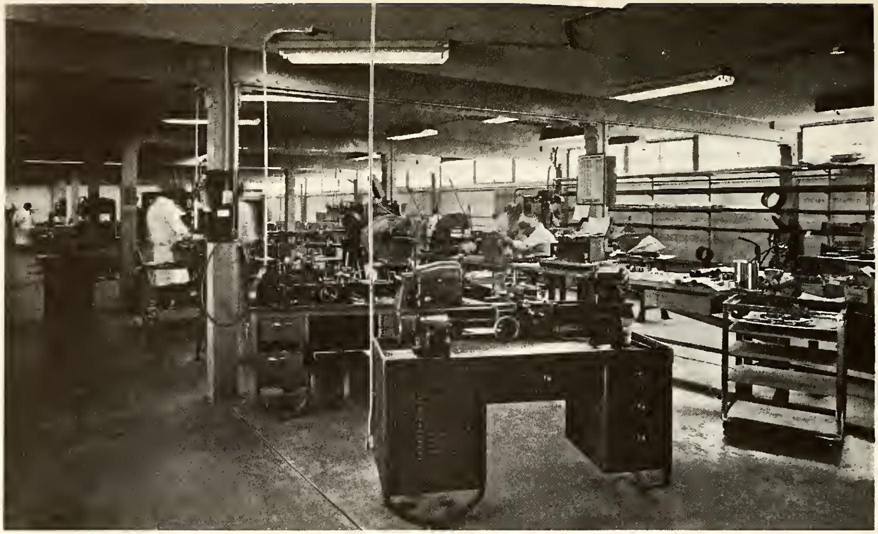
Left: northeast, or office wing. Opposite page: the long assembly area wing, with office wing at right in photo above, and at left below

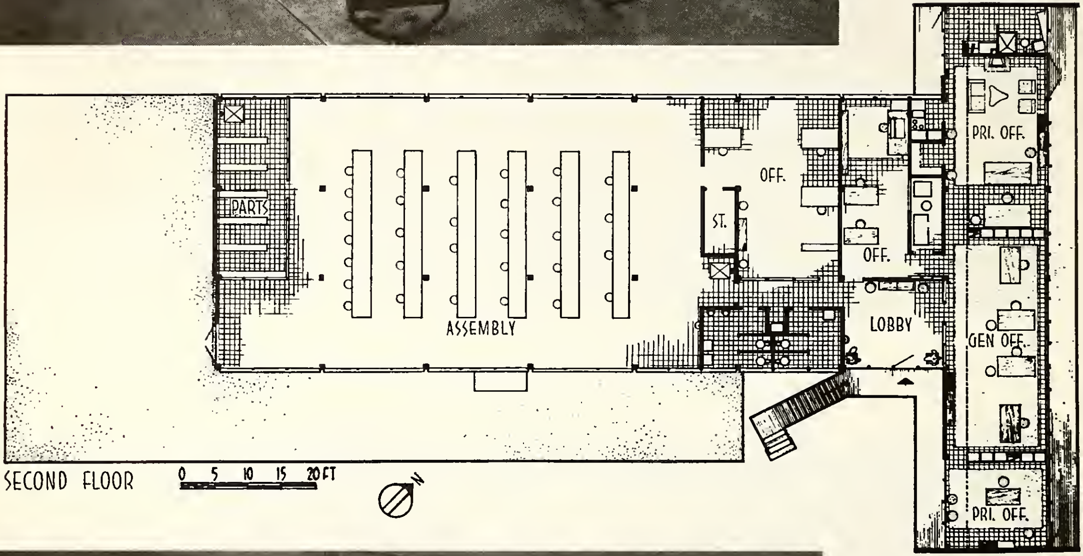
and laboratory are grouped in the northeast wing, with the large shop and drafting room area opening out at a 90 deg angle directly from the laboratory and lobby. The manufacturing group occupies the long southwest wing of the second floor, and has its own offices adjacent to, but separate from the offices of the merchandising company which has the entire northeast wing on this floor (plan, page 118). Stairs lead directly from the entrance court to the lobby serving these two groups.

Since the southwest wing is long and narrow, the major working areas receive a maximum amount of natural light from both sides. This is supplemented by fluorescent lighting; the fixtures are aligned with work benches and machinery and planned to give good local as well as overall illumination.

Foundations are concrete, framing is post and lintel. Walls are prefabricated concrete-block panels, with plywood board on the interior. Ceilings are acoustic tile in offices, fiber insulation board in shop areas. The building is air conditioned throughout, and heated by warm air.

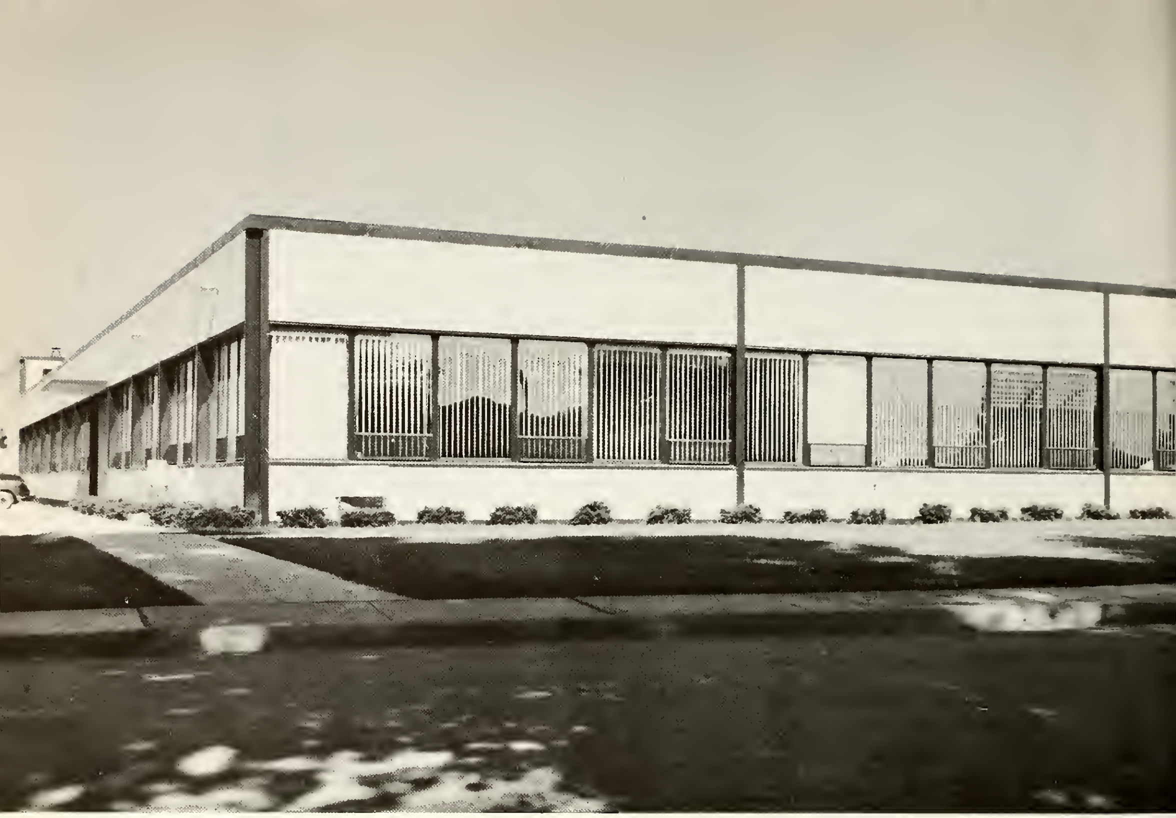





SECOND FLOOR

Roger Sturtevant Photos

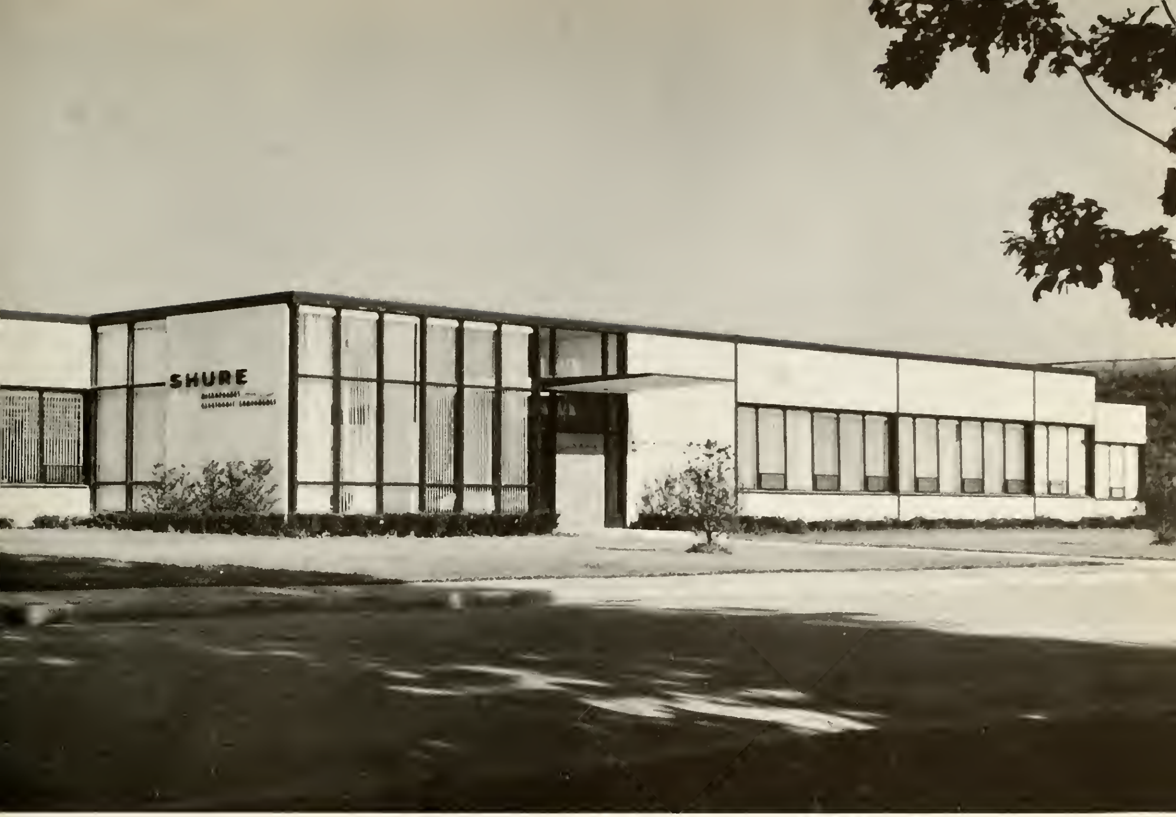
Merchandising firm's offices on the second floor were planned with visitors in mind. Carpeted and comfortably furnished, they follow the general color scheme used in rest of building, with light green walls and off-white ceilings. Large windows along entire east side of this wing let in ample daylight; glare is controlled on second floor by roof overhang, and on ground floor by full-length balcony



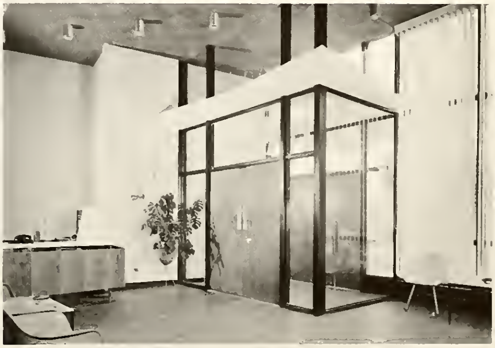
PLANT FOR ELECTRONICS

Shure Brothers, Inc.
Evanston, Illinois
A. Epstein and Sons, Architects and Engineers

Presumably this clean little manufacturing and office building could have been built for any of the light industries, but it seems peculiarly fitting that it is actually for a manufacturer of electronic components. Elements of the building are small and their use is clear and precise. It seems a fitting expression for a precise and definitely modern industry. The building is enclosed with brick walls, using face brick on three sides. Clear height is approximately 12 ft to the under side of the steel framing. Column spacing is 25 by 40 ft. The floor is 6-in. reinforced concrete, with hard steel troweled surface treated with liquid hardener. Windows are of projected steel sash, glazed with clear and obscure glass. Interior partitions are of concrete block, painted in finished areas.



Hube Henry, Hedrich-Blessing



A CASE STUDY IN PRECISELY CONTROLLED

Hedrich-Blessing

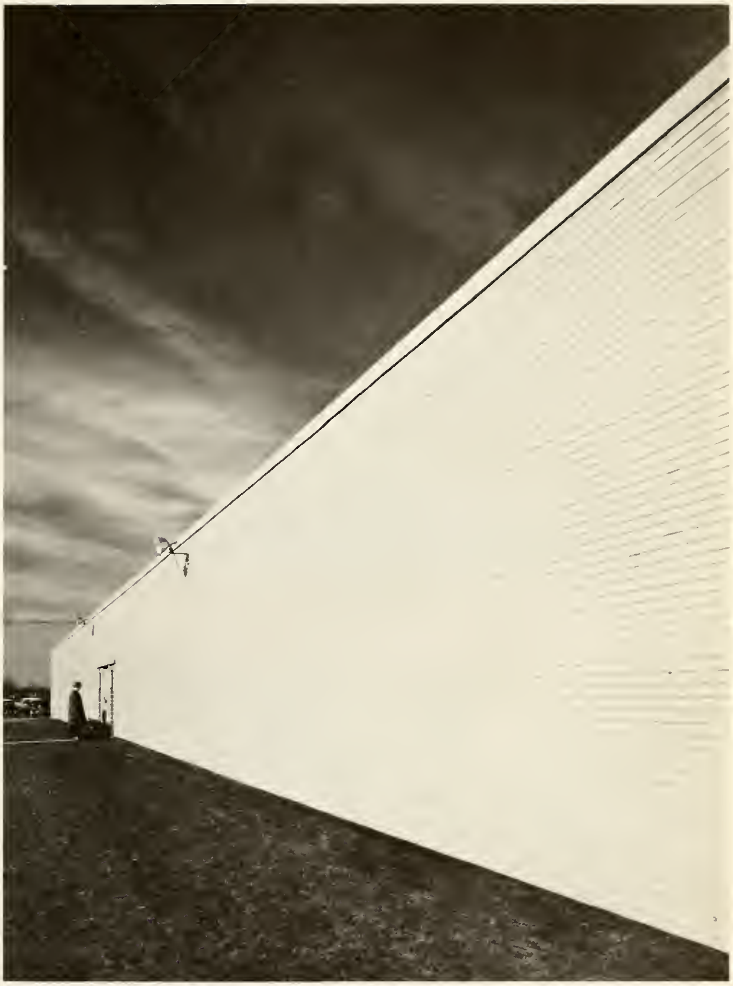
C. P. Clare & Co. Plant,
Chicago

Rapp and Rapp, Architects

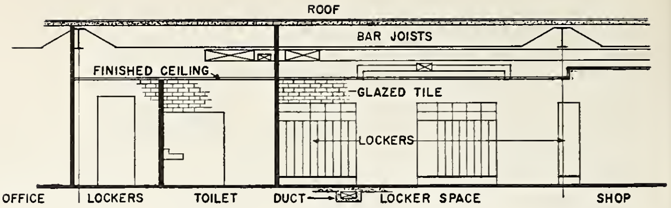
Norman E. Bueter,
Mechanical Engineer

William H. Koenig, Builder

ENVIRONMENT



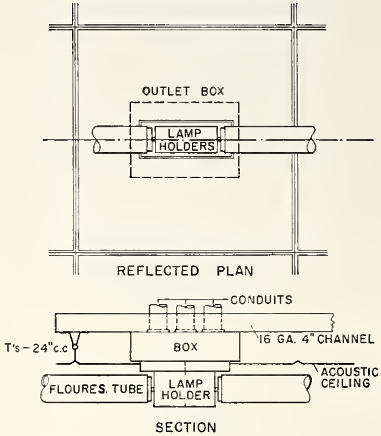
Since dust and dirt are the principal causes of failure in sensitive electrical relays, every effort was made to eliminate those hazards in this plant for such devices. An environment proper for delicate manufacturing processes was here created by carefully designed and controlled air conditioning and lighting systems in a building completely devoid of windows except at the main entrance lobby. Metal pan acoustical ceilings, washable ceramic tile walls and light colored asphalt tile floors make for easy maintenance of cleanliness within the manufacturing area. In addition to a cheerful lunch room and lounge, there are open air recreation areas for the employees.

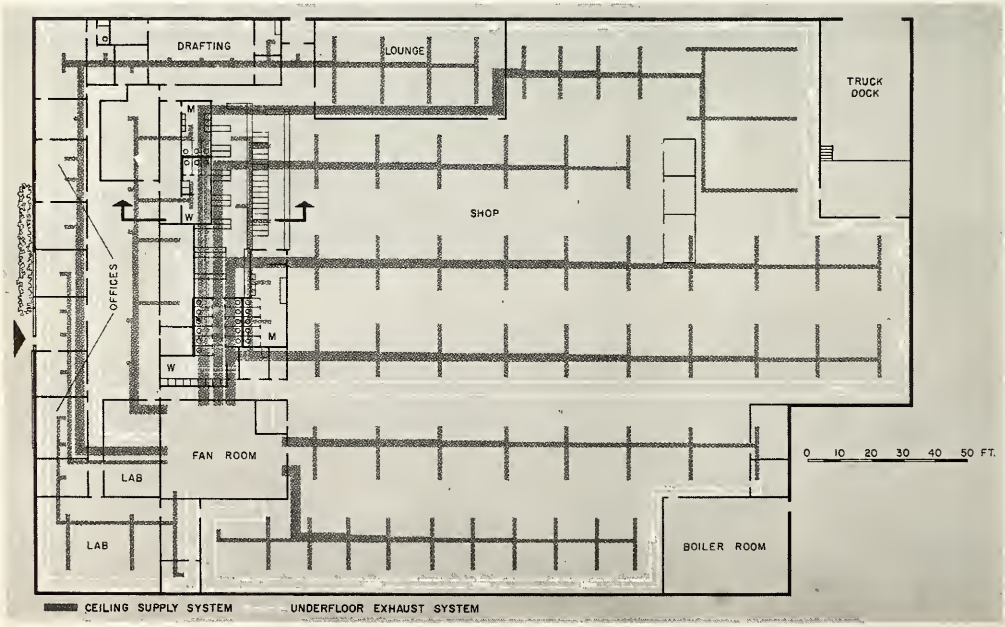


The section at right shows roof and ceiling construction, overhead supply ducts, underfloor returns. Detail of lighting, below, shows method of surface-mounting 4-ft fluorescent tubes and integrating their length with the 12-in. modular pattern of the ceiling

The plan, which is drawn to show the pattern of ceiling supply ducts and underfloor returns, is a relatively simple one. The fan room is located between the office block and the large central manufacturing area. The latter is cut into at the top of the plan by the employes' lounge and at the right by the truck dock and the boiler room. The air supply is cleansed of dust and smoke particles by electronic precipitation before being heated or cooled, humidified or dehumidified, and is then circulated through a system that is unusual in furnishing five to six times the conventional number of directional outlet grilles in order to provide an unusually heavy supply. Air contamination such as odor, heat, dirt, or smoke originating in the manufacturing processes is handled by exhaust grilles in the floor directly under the source. The supply of power and air is from floor ducts, hence nothing is suspended from the ceiling to catch or hold dirt.

The lighting system, rows of surface mounted fluorescent tubes on 4 ft centers, was chosen after exhaustive tests; provides 75 ft candles of practically shadowless light at bench level.

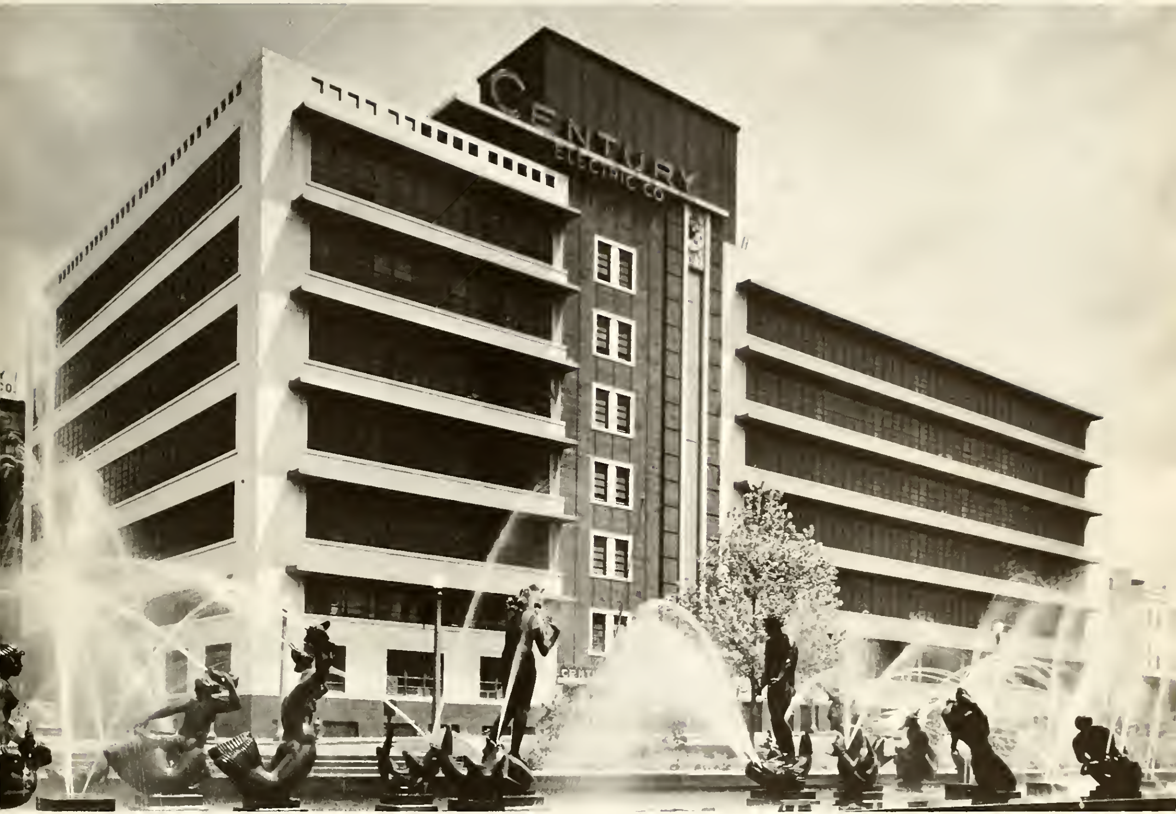




The 9-ft 3-in. ceiling, above, is finished with alternate panels of perforated metal acoustic tile or plain metal tile, with insulation between them and the roof joists to seal out dust from above. Typical office at right; the manufacturing area below

Hedrich-Blessing

Hedrich-Blessing



CENTURY ELECTRIC COMPANY, ST. LOUIS

Wm. B. Ittner, Inc., Architects & Engineers

This manufacturing plant faces the old Union Station across Aloe Memorial Plaza on St. Louis' Market Street. Focal point of the plaza is Carl Milles' fountain with its graceful figures and soft play of water. The juxtaposing of fountain and industrial plant sets up an interesting contrast between the lithe forms of the sculpture and the disciplined lines of the building.

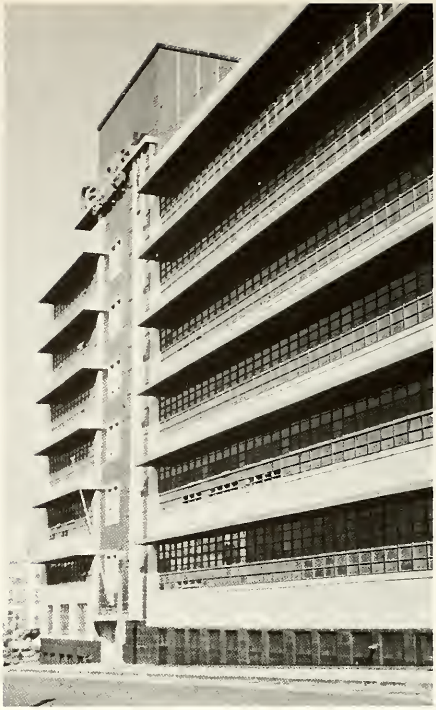
The factory as we now see it was built in two stages: first a one-story plant designed to support seven more floors — three years later the present structure built about and above the original one. The lot was formerly a pond and presented problems in the design of the footings.

The program called for a large clear factory area for light manufacturing served by passenger and freight elevators. Such a plant is suitable for multi-story construction in a downtown area since it presents no health hazards or public nuisance. The top five floors are at a common level throughout, but due to the loading dock and freight handling facilities on the side street, there is a stagger in level here which results in a building seven stories on the plaza and eight stories on the side street. Atop the roof is a large, glass enclosed all-purpose room suitable for worker-management meetings, film projection and recreation. This room opens to a terrace affording a pleasant view of the city.

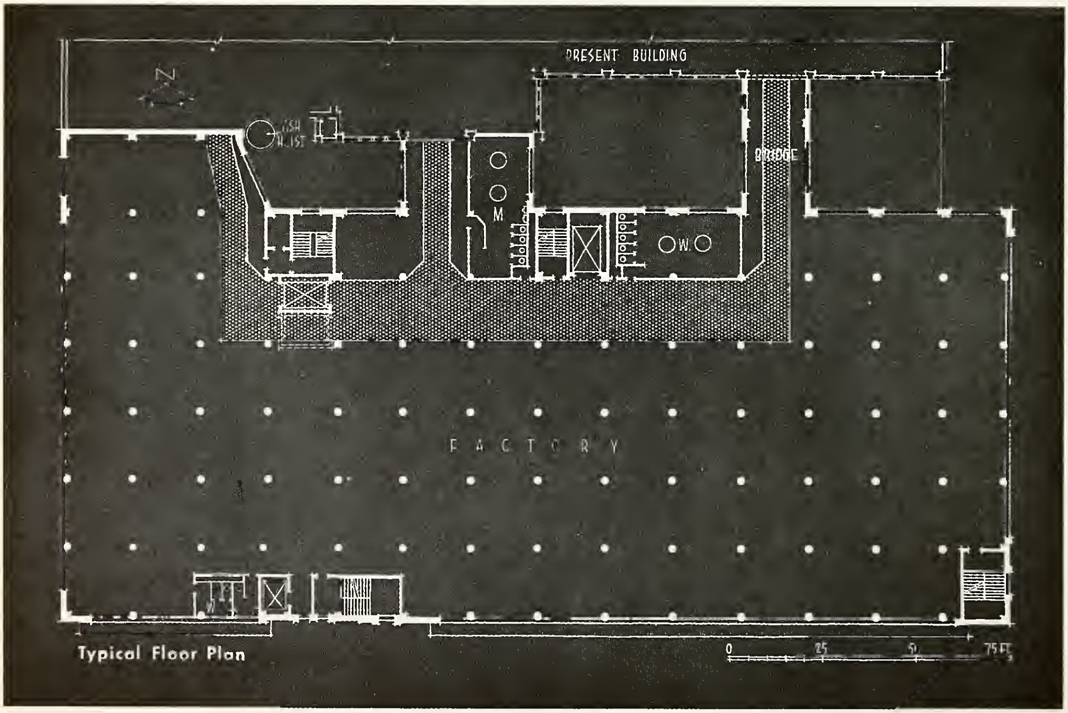
Structure is a reinforced concrete frame with concrete rib tile floor construction. The exterior is faced with terra cotta in dark green and cream color. Exterior trim is satin finish aluminum throughout.

Horizontal sunshades on west facade (right) are 3 ft 6 in. concrete extensions of the floor slabs. Top surface is lead covered — bottom is concrete in coffered form. Vertical strip of glass block lights the main stair of the building.

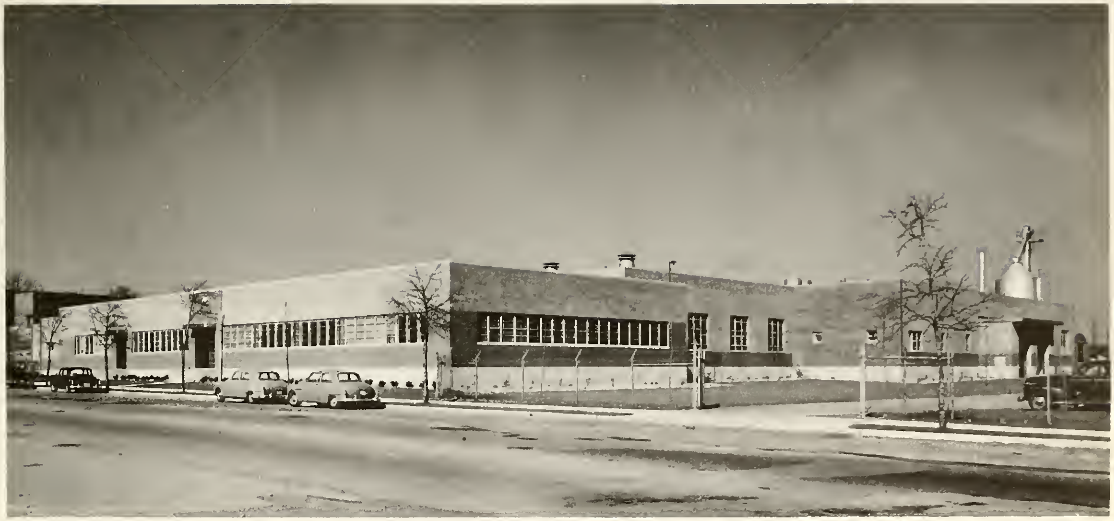
Plan of typical floor (below) shows open area for light manufacturing. Shading indicates circulation and connection with existing building adjacent, owned by the same company



Lester C. Haeckel



Typical Floor Plan



PLANT DESIGNED FOR EMPLOYEES' WELFARE

Asten-Hill Manufacturing Co.
Philadelphia, Penn.

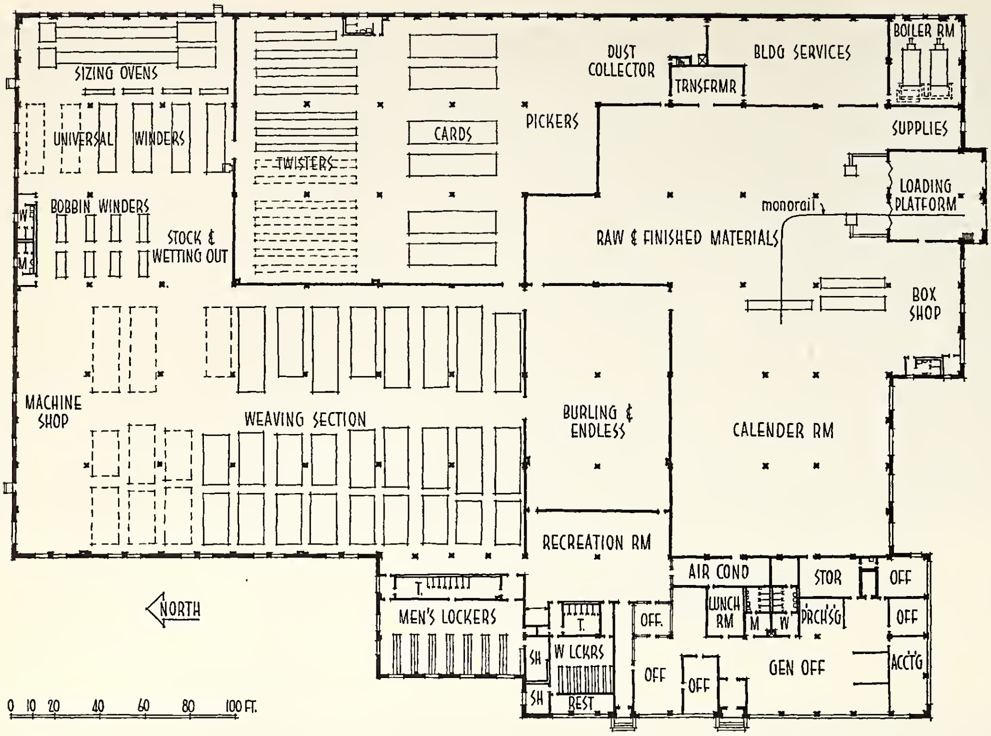
The Ballinger Co., Architects and Engineers

Apart from the usual considerations for efficient processing layouts, the designers of this asbestos dryer felt plant were faced with a major problem of controlling asbestos dust. Uncontrolled, the dust accumulates on all projections and rough surfaces in process areas, and presents a silicosis-like health hazard to employees. Dependable control of temperature and humidity is also vital in manufacturing the felts. The goal of the owners was to construct a plant which would combine production efficiency and product control with pleasant and healthy working conditions.

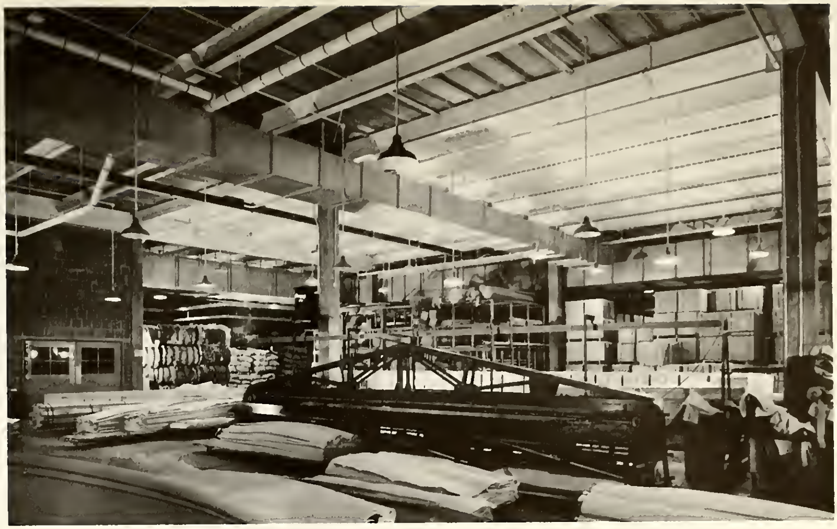
The resulting design succeeds in providing good solutions to these problems within a neat, attractive structure. Especial attention was given to the employees' welfare, even to selection of a site near the workers' homes, although it was known that the deeply filled ground would require pilings. Other provisions include a parking area, pleasant locker, shower and toilet rooms, good lighting, and a general purpose room for lunch and recreation. Asbestos dust is removed from segregated process areas by a carefully planned system of hoods, ducts and fans, together with tunnels under the floor. The dust is then conveyed to electro-static filters and to a cyclone tower where it is salvaged for other use. A portion of the air is reconditioned for recirculation. Separate comfort air conditioning is provided in the office areas.

Joseph Molitor Photos

The one story plant is surfaced with bonds of light and dark brick, limestone trim, polychrome terracotta at main door. Flat roof employs special regulated drainage discharge system

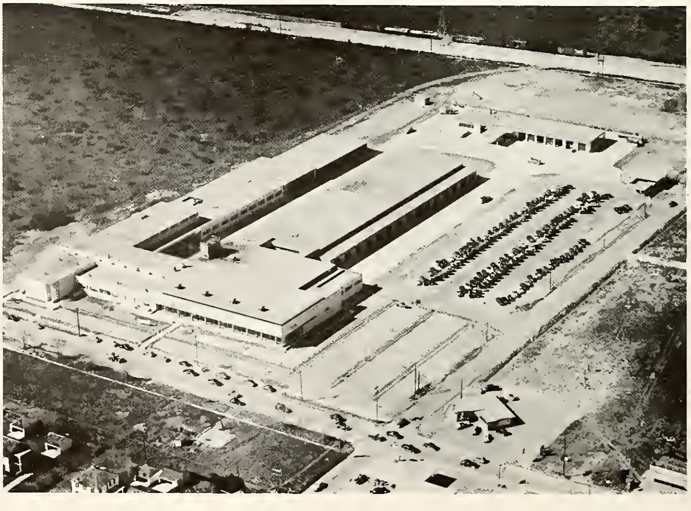


Provision of clean, comfortable working areas has considerably improved employees' morale, with resultant increased efficiency. The well-lighted, air conditioned weaving section (left) is typical of these areas. The steel frame structure is designed around a continuous materials flow line, passing successively through the blending, carding, twisting, spooling, spinning, weaving and calendering departments. Expansion space for additional equipment (dotted lines on plan) is provided in each section. Glazed tile walls and hung plaster ceilings in these areas help minimize dust problem. Ceilings are left exposed in such other rooms as the raw and finished materials section (top right). Offices (bottom right) have plaster walls, acoustic ceilings, asphalt tile floors



CONSUMER GOODS

I. B. Lindenthal Photos



Bottling Coca-Cola here requires a half dozen major buildings, a great fleet of trucks and an imposing array of materials handling equipment. This one pioneers a new system of loading and handling, and has become a prototype for several plants now building. It also won an award from the Texas Society of Architects, 1950 Awards Jury

PROTOTYPE FOR BOTTLING PLANTS

Houston Coca-Cola Bottling Company

Houston, Tex.

Stone & Pitts, Architects and Engineers

When production rises to 1200 bottles a minute, or 22,000 cases a day, even so simple a process as bottling Coca Cola involves construction on a big scale, and sets before the architects some problems of layout and material handling to test their proverbial ingenuity in these matters. The architects for this building studied 43 bottling plants in three countries, developed a new scheme, tested and revised it, until this plant became a pioneering project of considerable importance.

Its central feature is the "Drive-Thru Building" (see page 136), with 15 lanes where trucks disgorge empty bottle cases and load full ones with a minimum of manual handling. Conveyors carry off the empties and deliver filled cases to raised platforms between lanes. The system saves as many as 44,000 manual case-handlings in a single day. And the plant is now the prototype for several others the architects are planning.

The drive-through system was originally suggested by engineers of the parent Coca-Cola company, but had never been tested. The architects translated it into a full plant parti, complete with conveyor systems, gravity feed lines and so on. Then a model was constructed for study. When this began to look good, a full-scale mock-up was built, consisting of one lane with operable conveyors. This was tested many times with actual trucks and bottle cases. The tests resulted in several changes in original thinking, all of which were incorporated in final plans for this building. The system saves time for an expensive fleet of trucks as well as eliminating much handling of cases, and 75 of the trucks can park in the lanes overnight.

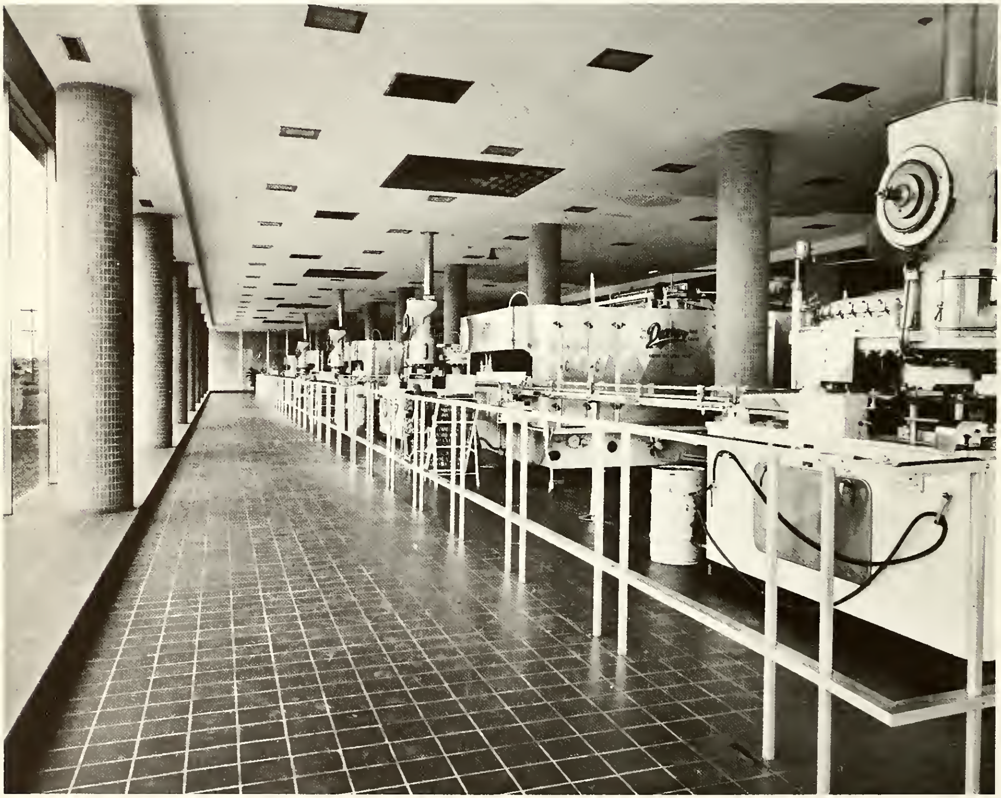
The several buildings are deployed around the conveyor lines, so that the various elements of the process feed into the lines at the proper point, with mechanical handling wherever possible. All material flow lines, conveyor systems and bottling machinery arrangements were designed and detailed by the architects. So are assembly line methods introduced in an industry grown to huge proportions but always beset by inefficient handling facilities and always struggling to expand.

Architecturally the buildings exhibit their functional aspects quite naturally. The trucking buildings are of factory type construction with corrugated asbestos panel walls. The main building, housing bottling machinery and offices, is faced with face brick and limestone, and with tall strip windows on the first floor, for the bottling works is really a great display room for a major industry.

I. B. Lindenthal Photos

Auditorium wing, main building

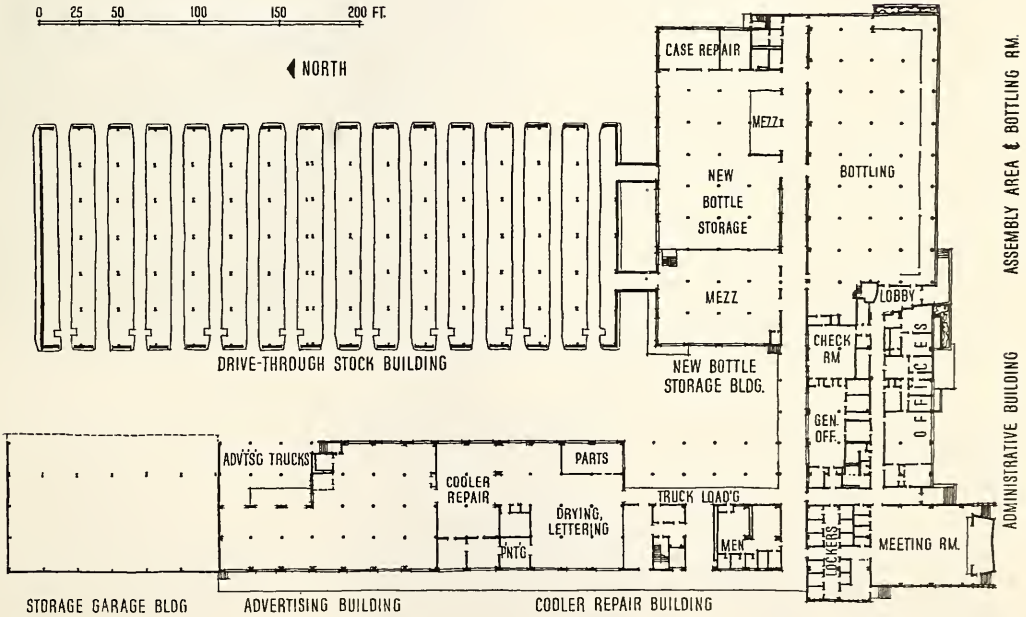
Main entrance vestibule



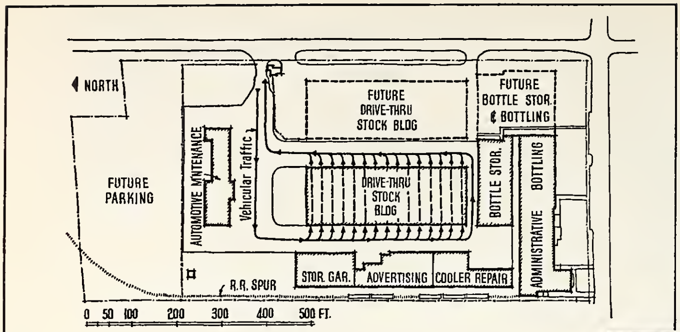
Bottling plants for many years have put their intriguing gadgetry on public display. The Houston plant, capable of cleaning and filling 1200 bottles a minute, offers this imposing line-up for delegations of visitors

View of principal lobby

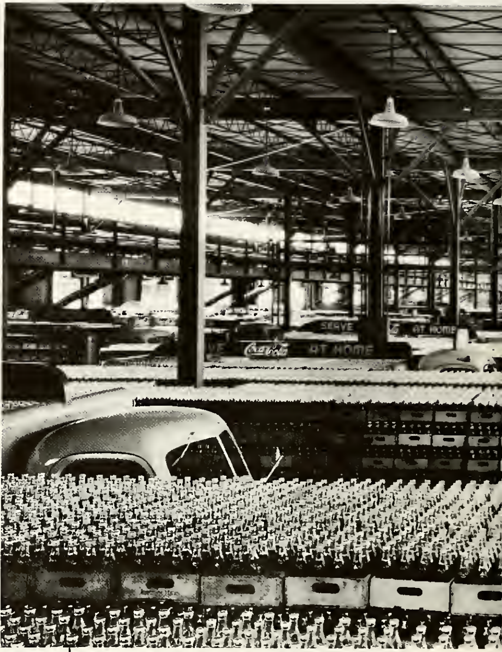
Interior of auditorium

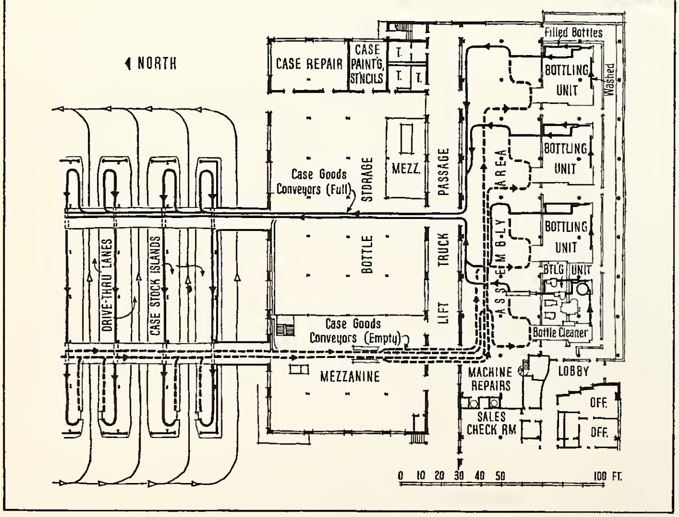


Principal group of buildings puts all functions except automotive maintenance in a U-shaped disposition on the basis of handling problems. Advertising display material and bottle coolers come in, or go out, either by rail or by truck; new bottles and cases usually arrive by rail, are transported within the plant by lift trucks. Bottle storage building is on conveyor route from bottling room to drive-through loading building, so that bottles may be easily added to or subtracted from the conveyor lines



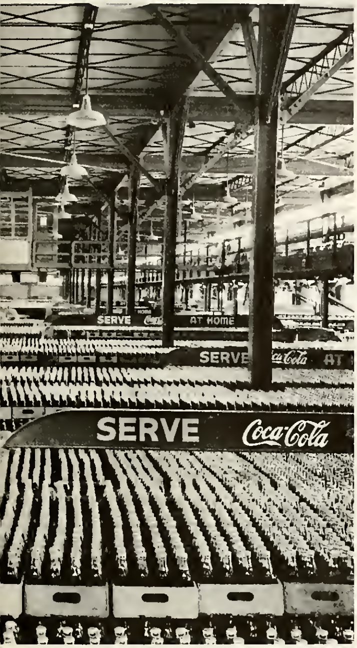
Site plan above shows route of trucks into plant, through "drive-thru" building for unloading and loading of cases (center photograph). Case conveyors cross these lanes (diagram below), pick up cases of empty bottles, move through bottle storage building to bottling units. Cases of filled bottles go on along conveyors to forward end of truck lanes for loading. Main conveyors go overhead across truck lanes, secondary lines break around and downward along lane platforms, pick up empty cases at end of platform, then rejoin the main empty conveyor



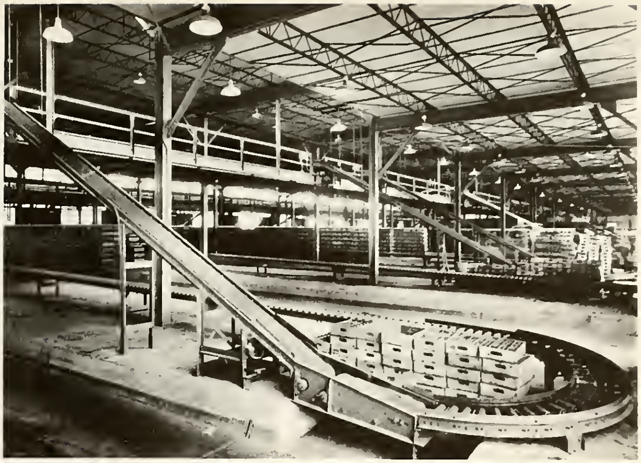


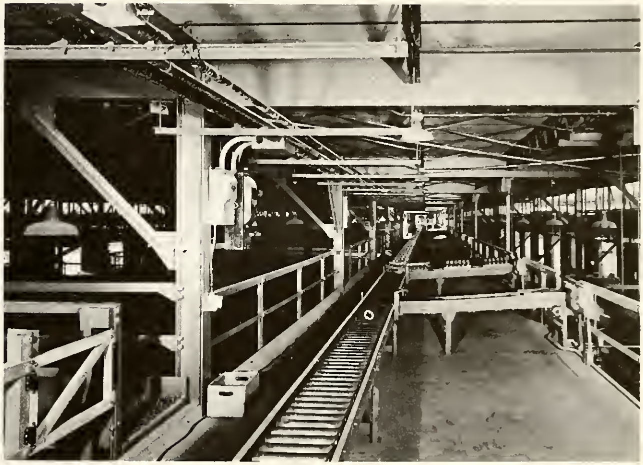
Cases, either empty or full, are stacked in tiers on platforms right beside truck lanes, reducing manual handling to a minimum

I. B. Lindenthal Photos

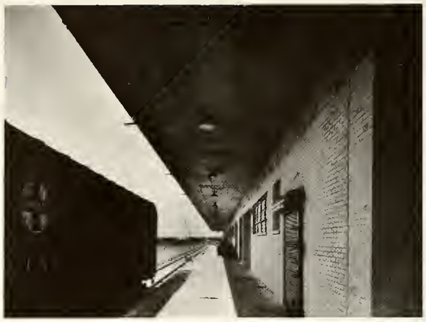


Control center for conveyor system, right, is in bottle storage building. Here cases are directed toward machines on schedules

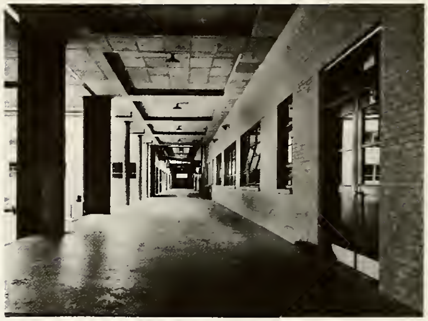




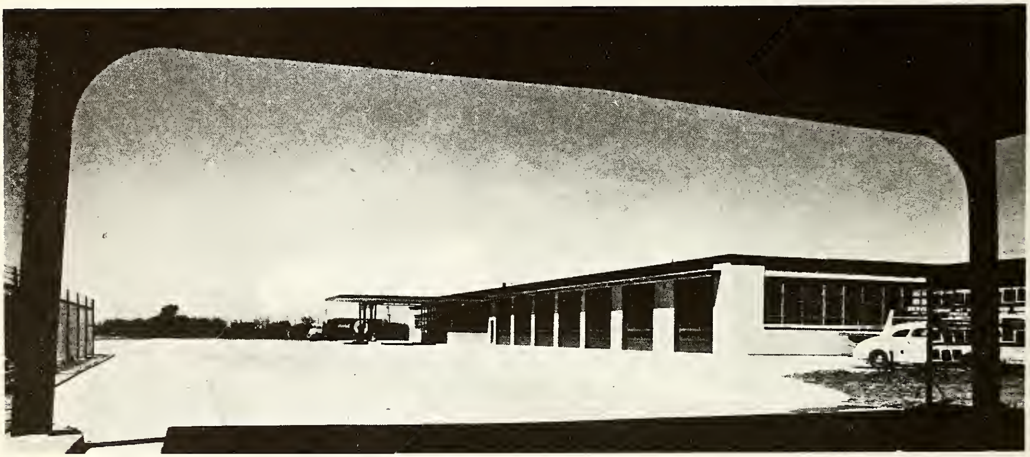
I. B. Lindenthal Photos

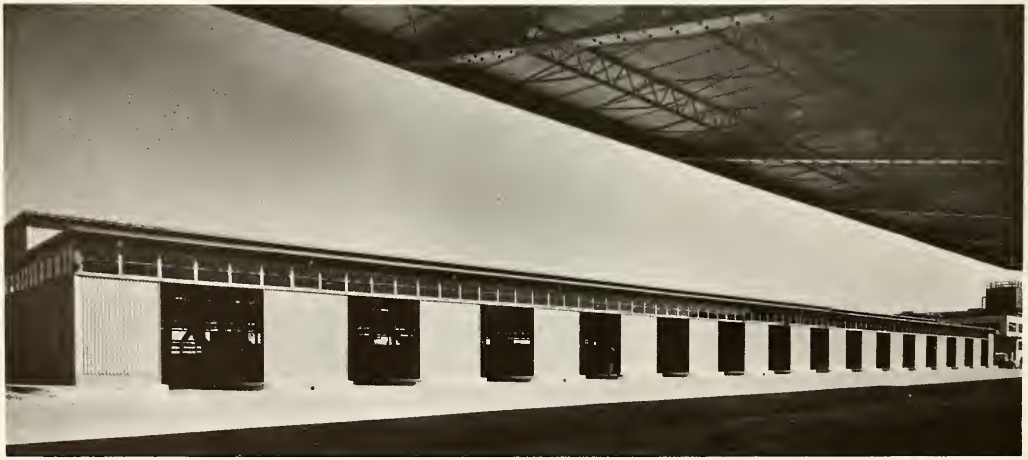


Railroad spur and receiving dock



Truck dock, opposite side of building

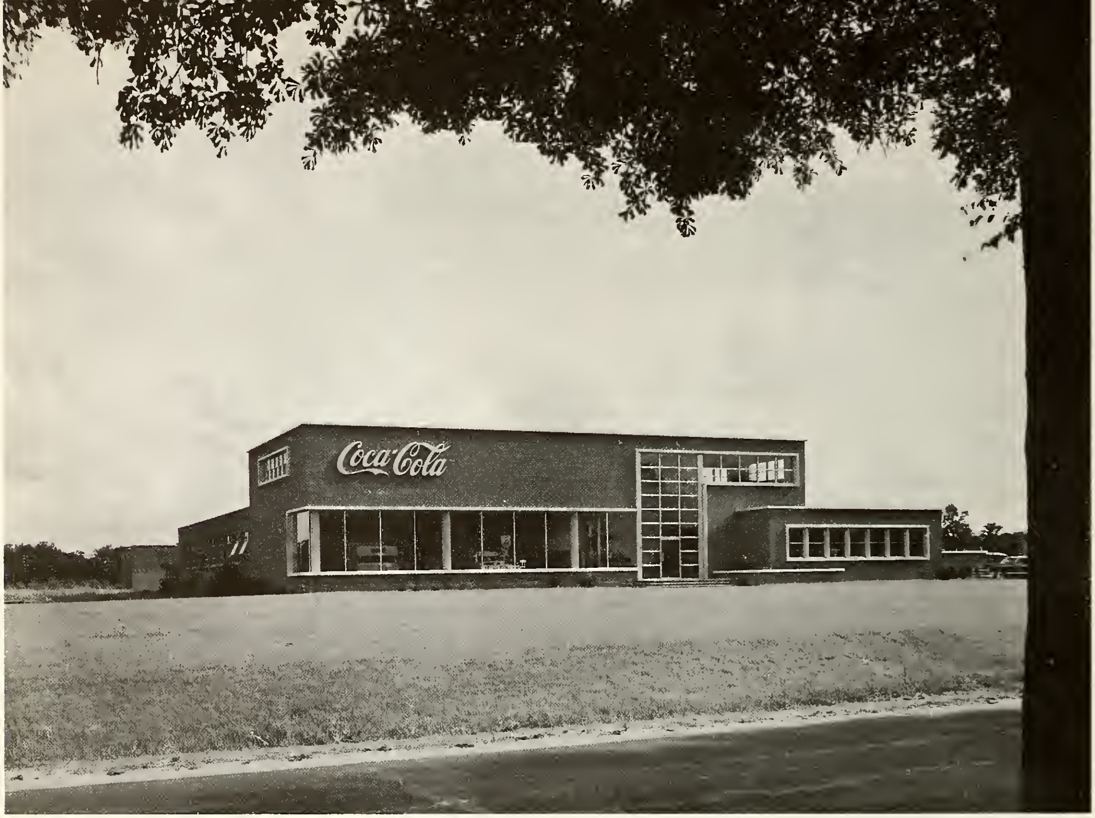




Truck and auto entrance

◀ *Opposite page, center: Automotive maintenance building*

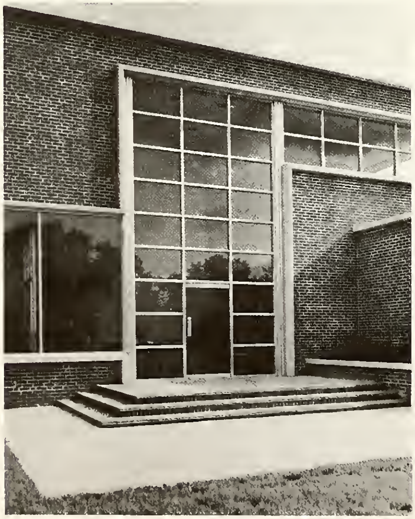
◀ *Opposite page, bottom: Drive-thru building has 15 lanes*



SUBURBAN SITE FOR COCA-COLA BOTTLING PLANT

Kinston, North Carolina

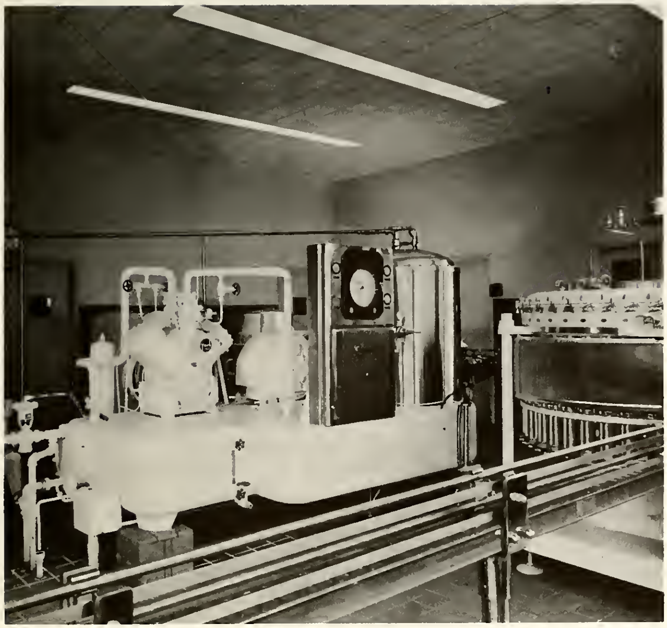
John J. Rowland, Architect

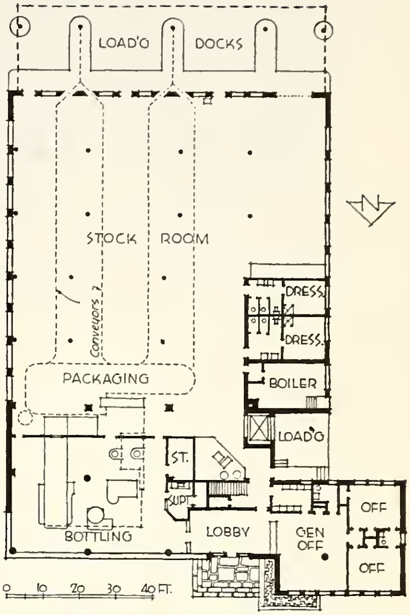


The site for this Kinston, N. C., Coca-Cola bottling plant, on the outskirts of the city, was selected to avoid down-town traffic congestion and provide adequate facilities for off-street loading and unloading.

Following the plan of most Coca-Cola bottling plants — in which the bottling process is displayed to the public — the rear warehouse section is fronted by a large, window-walled bottling room. Bottles travel by a conveyor system from one to the other, affording a capacity of 12,000 bottles per hour. On the second floor, above bottling room and lobby, are caustic, syrup and file rooms, as well as storage space. lobby and conference room.

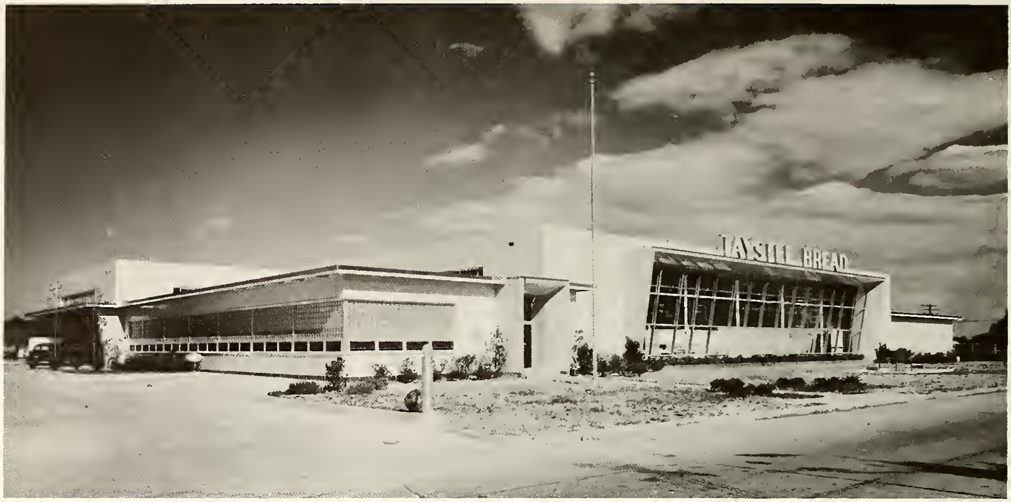
Completed in 1949, the plant was planned for the addition of another unit to the east. Planning consultant was the engineering department of the Coca-Cola Company of Atlanta of which Mr. Lynn LaGarde is chief engineer.





Joseph W. Molitor

The bottling room, above and right, has quarry tile floor and wainscot and acoustic ceiling. Fan blows across front window-wall to prevent condensation. The offices and lobby have rubber tile floors and acoustic ceiling and are equipped with year-round air conditioning

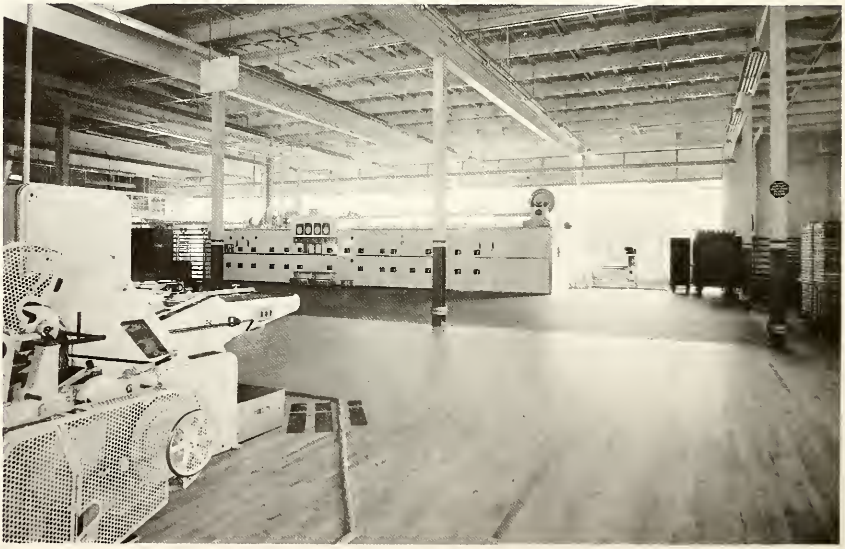


ASSEMBLY-LINE PLANT FOR BAKING BREAD

Building for Taystee Baking Co., Beaumont, Texas

THE ONCE-SIMPLE PROCESS of baking bread has now become mechanized and streamlined, until a commercial bakery offers the same problems of a factory for, say, automobiles. Every little process, down to the pinch of salt, is a matter of so much time on the perpetually moving line; maybe they still grease the pans by hand — at least they wash the trucks that way. So the architect works with materials handling equipment, designs an assembly line, leading it in and out of warming ovens, cooking ovens, cooling cabinets, all neatly calculated as functions of time and temperature, so that this little plant can turn out 5000 pounds of bread per hour.

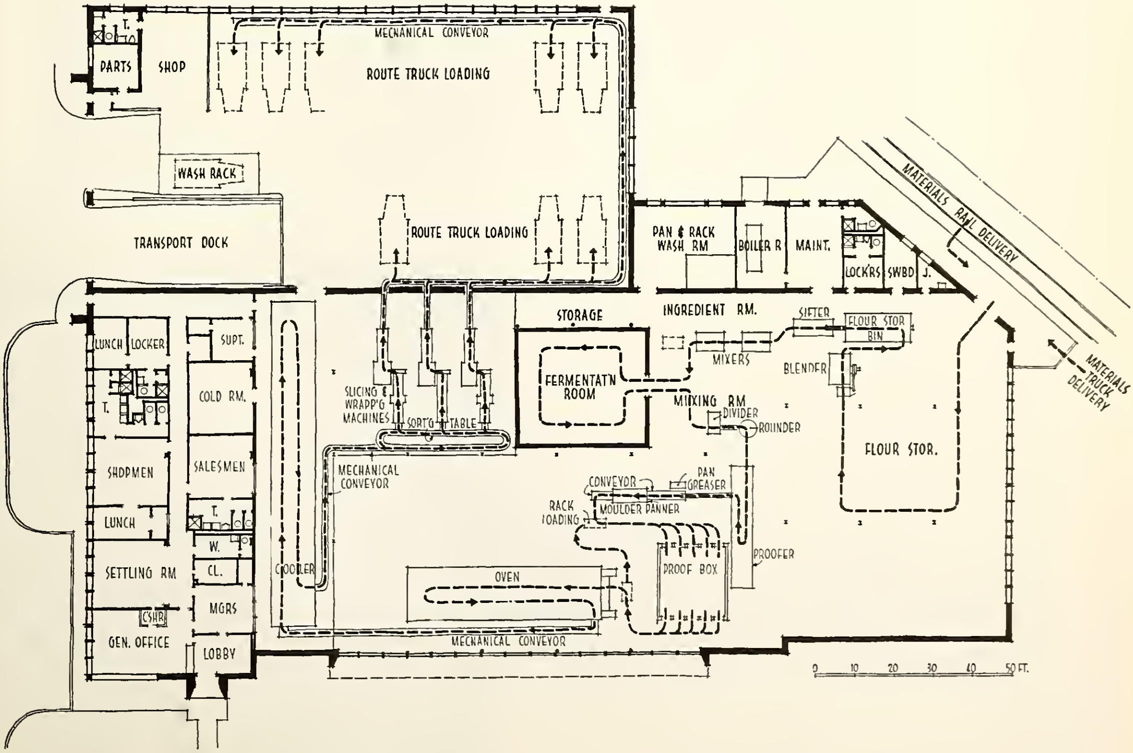
Building is constructed of glazed hollow tile, for sanitation in storage and process areas. A special high velocity ventilating system removes flour dust from storage areas and heat from processing areas.



Like many another modern food plant, this one takes advantage of a location on a busy highway to display its main processes to the public. The assembly line is carefully figured out to put the ovens right behind the front windows

Stone & Pitts, Architects and Engineers

Taylor Milton, Mechanical and Electrical Engineer



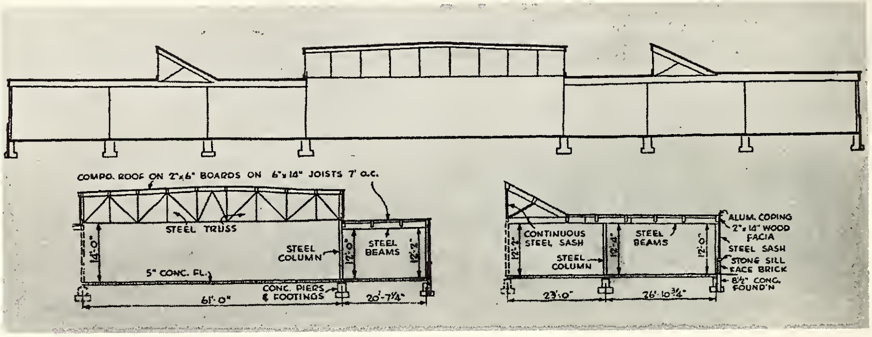
TWO VARIATIONS OF PROTOTYPE DESIGN

Two Food Products Plants at Clearing Industrial District, Chicago

John S. Cromelin, Architect

Photos: Hedrich-Blessing

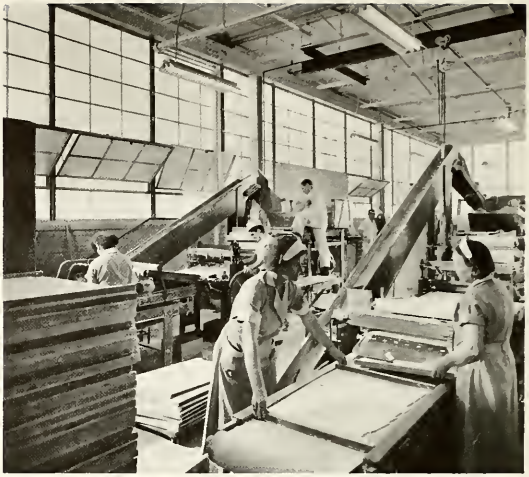
At this old and well-established industrial subdivision, small factory buildings tend to follow a prototype design worked out many years ago (see sections below, from Architectural Record, December 1946). Here are two similar buildings, both for food products, which follow the pattern in some respects, differ in others. The basic scheme uses various combinations of more or less standard bays, wider center bays with trussed monitor roof, A-frame roof sections to light interior bays, mostly with wood joists on steel beams, and mill type of roof construction. The Melville building, in which speed was of paramount importance, was designed as far as possible to use a supply of fabricated steel which the Clearing Company already had. Minor adjustments were made in column spacing, and in a wide bay where bar joists were used.



In the Chapman & Smith building, a standard bay of 26 by 30 ft was used, to meet special pallet storage requirements. Alternate bays were raised to provide monitor lighting, with the usual steel beam and wood joist construction. Here a variation was made: wood joists were placed above beams, instead of set flush on steel angles. In these bays this scheme saved on sprinkler heads and connections.

In Melville building speed of construction was necessary, as previous quarters had to be vacated to widen street

Chapman & Smith makes a display of its new building for visiting women's groups, as company makes bakers' mixes for doughnuts, pie crust, cakes, also jellies and fruit syrups



Photos above: Hedrich-Blessing

Melville plant, making many different kinds of confections, has very complicated production flow, and resulting lines have a Rube Goldberg look; but they are result of much study and many rejections, and they work

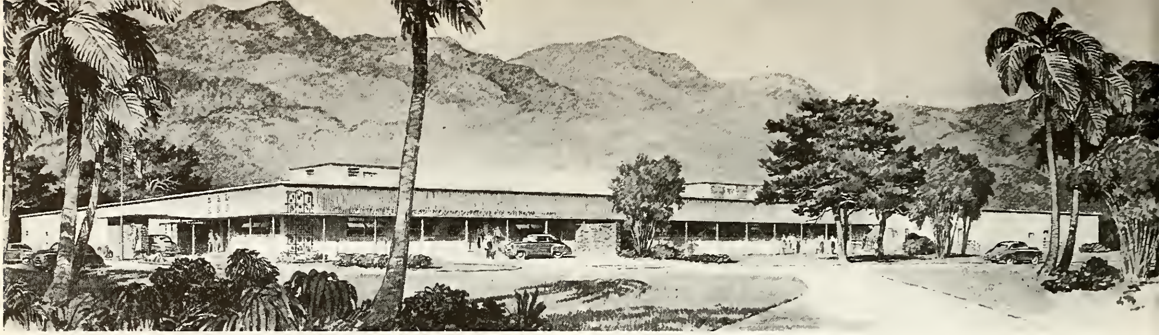
---

Chapman & Smith laboratories are air conditioned, as are also offices and kitchens. Below, right. completely enclosed truck dock is necessary for loading and unloading perishable materials, is lighted by monitor

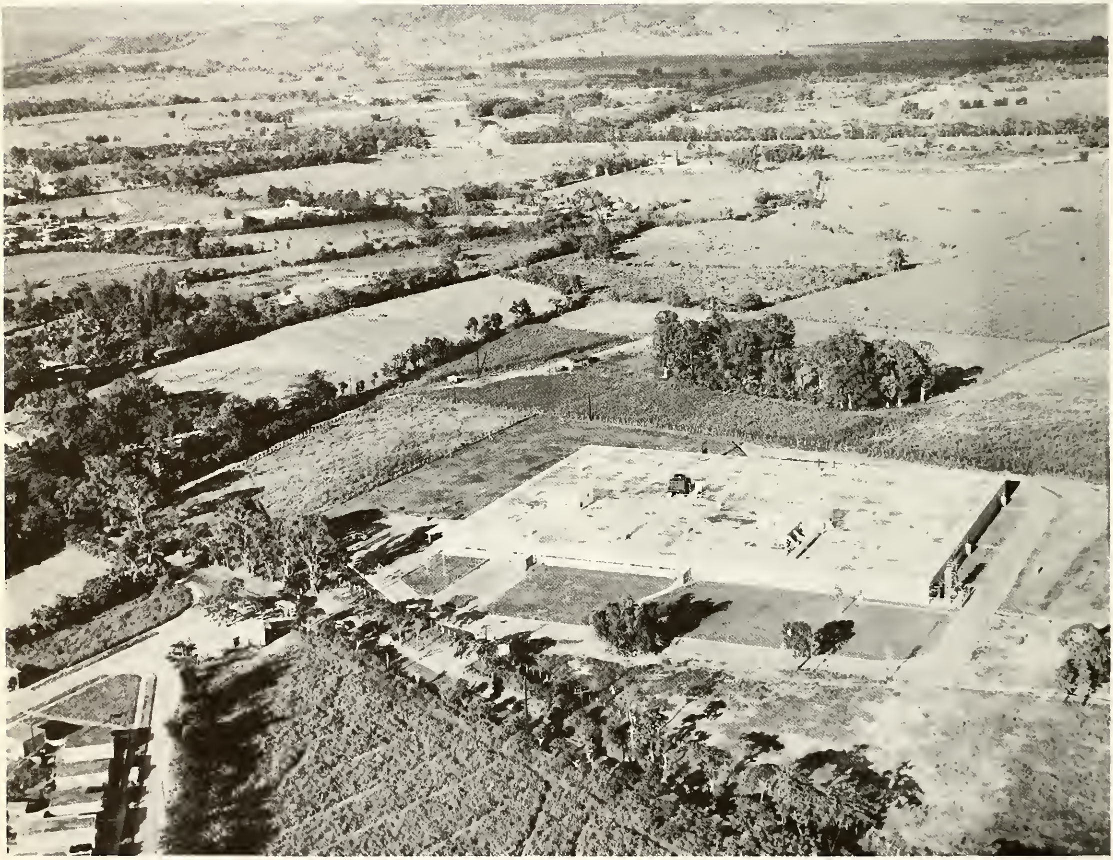
Photos above: Hedrich-Blessing

Most of plant is quite open; some areas, however, develop explosive hazards of starch dust, have elaborate precautions

"Wet room" has quarry tile floor and wainscot, to protect it against the corrosive action of fruit juices used in jellies



FACTORY FOR CONSOLIDATED CIGAR



From the site at Caguas, in the heart of the tobacco-growing district, a main paved highway connects with San Juan, 40 minutes by truck; the labor force, of high quality, comes from Caguas itself and from neighboring villages

Copyright 1954 by F. W. Dodge Corporotion

Hamilton Wright

CORPORATION OF PUERTO RICO

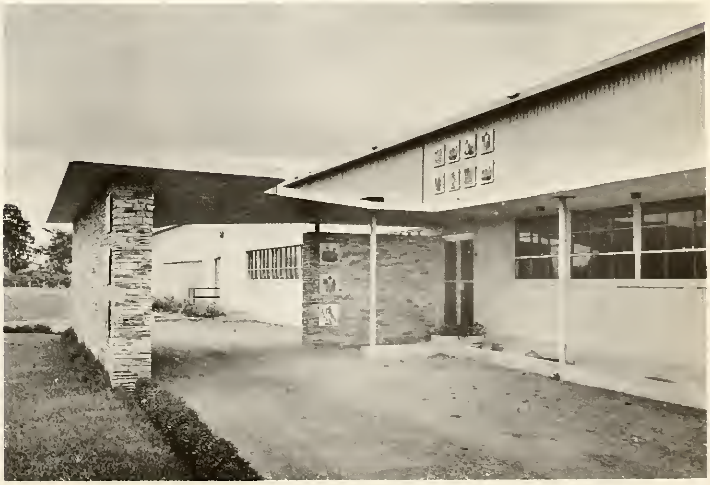
Caguas, Puerto Rico

In selecting this site, the architect worked with the client from the inception of the project, surveying many locations with the assistance of the Puerto Rico Industrial Development Company, a governmental agency. In addition to factors noted on the opposite page, criteria for final selection included the following: Bus transportation existed on the highways visible in the aerial view, to carry personnel to the factory; each of the intersecting highways had water mains (eliminating the need for a sprinkler water tower); sanitary sewers and high tension lines were available; an organized fire department was located ½ mile away (which reduced insurance rates); the land is a high plateau with well drained, level ground.

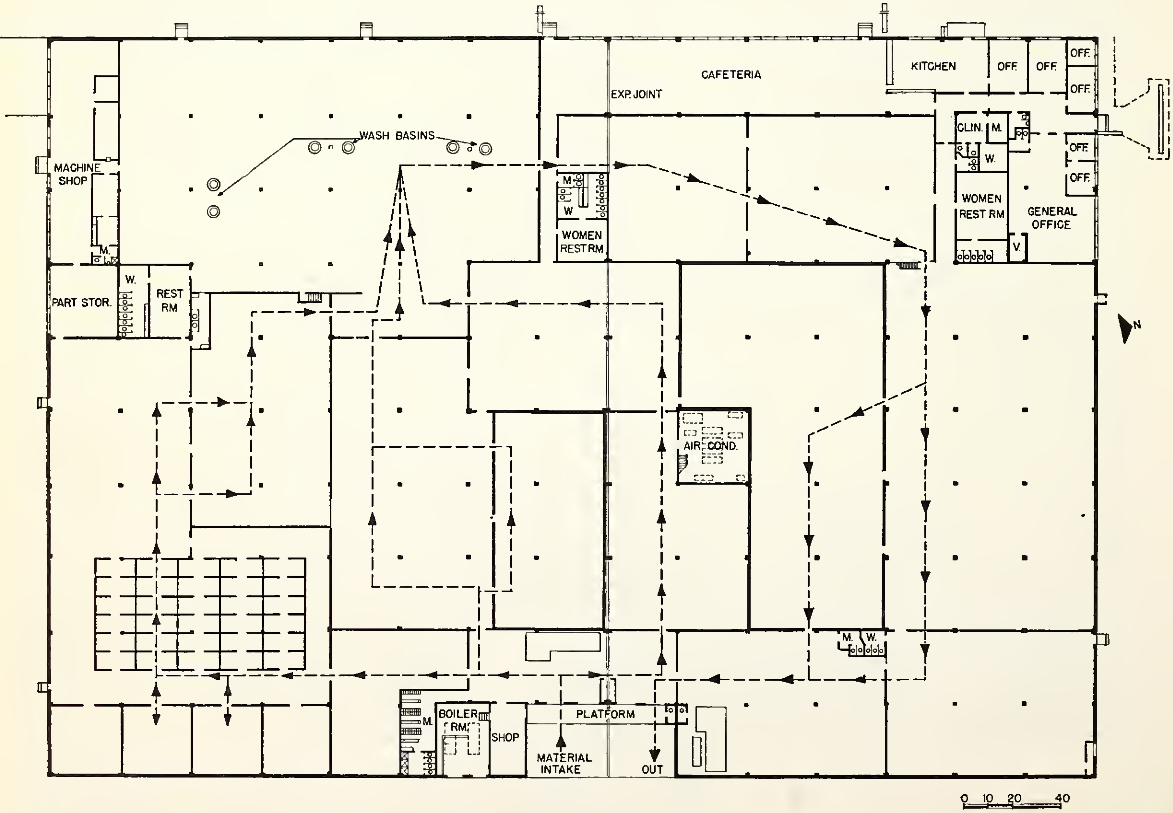
The building had to meet certain requirements. Cigar manufacture has changed in recent years from a hand operation to a highly mechanized, automatic one. Tobacco is very hygroscopic, so complete air conditioning is essential, particularly in Puerto Rico's extremely variable climate. Each step in the manufacturing process has different temperature and humidity requirements, and comfort air conditioning in nonmanufacturing areas is mandatory. The solution was found in a plant without interior corridors, with layout governed by production flow (see next page); intense sun load and efficient operation combined to dictate a windowless manufacturing area.

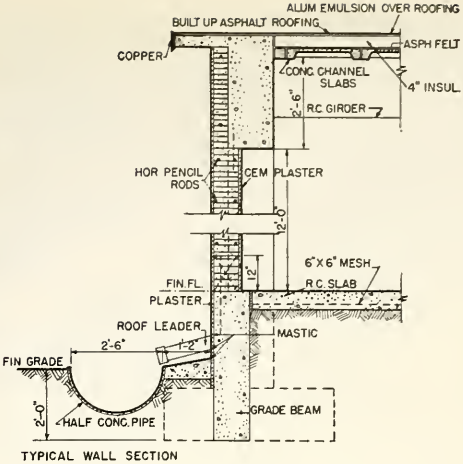
On the other hand, the labor force comes from a hitherto agricultural, tropical area; and so the interior of the carefully lighted plant is vividly colored, the building's grounds are expensively landscaped and game areas are to be laid out around it. Instead of being a cheerless working place, the plant is pleasant and far from monotonous. The exterior has coral walls, orange-color native flagstone and blue corrugated asbestos board over the main elevation. Colorful enameled copper plaques, displaying various phases of tobacco culture, emphasize the entrance. Structurally, the building is designed to resist earthquakes and hurricanes, with shutters for the few openings.

Joseph Douglas Weiss,
Architect

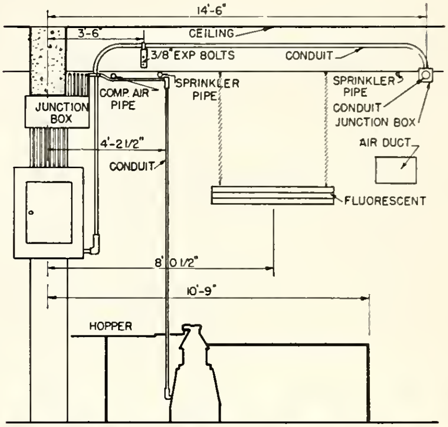


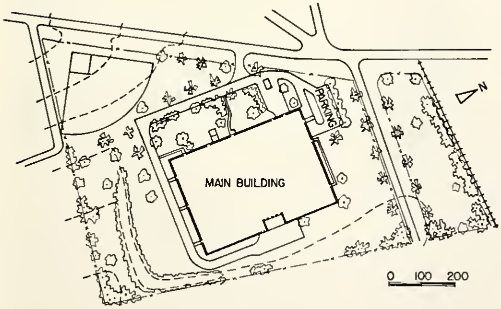
Hamilton Wright





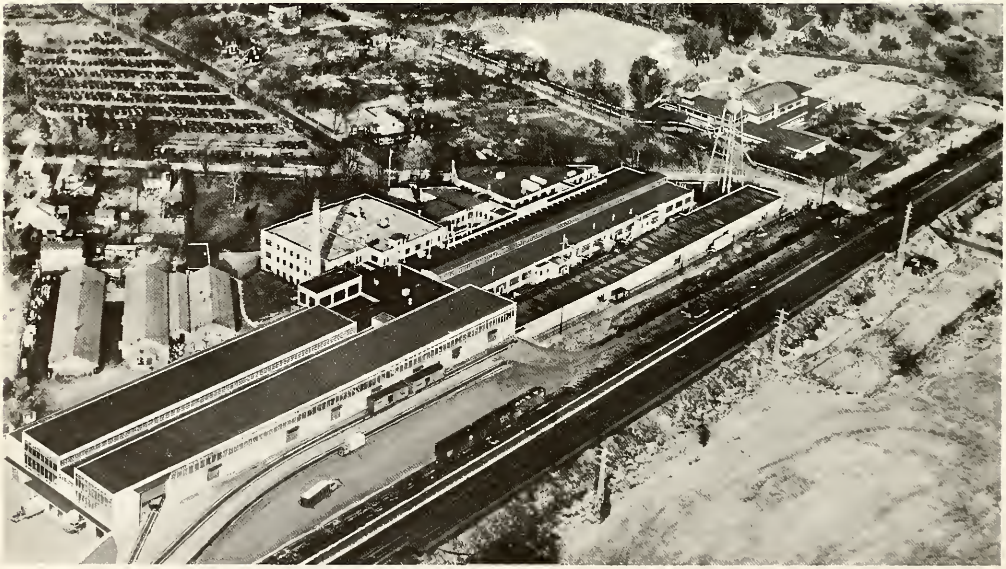
Photos: above, entrance lobby, cafeteria, view window so public can watch process from lobby; right, manufacturing areas. In detail above, right, rain spouts spill water from tropical downpours, too much for practicable sizes of leaders, into open gutter at grade which completely surrounds plant and feeds into adjacent drainage.





Detail of cigar machine services shows extreme care with which industrial fluorescent lighting units are positioned to prevent casting shadows on automatic machinery. Note also painstaking coordination of all service lines. Plot plan, above, shows eventual development of site

Joseph Molitor Photos



INDUSTRIAL BUILDING FOR THE ELECTROLUX CORPORATION

OLD GREENWICH, CONNECTICUT

Antonin Raymond & L. L. Rado, Architects-Engineers

The Electrolux Corp. has at Old Greenwich the largest single plant in the world devoted to manufacturing vacuum cleaners. Established at that location in 1933, its facilities have since been gradually enlarged. At the same time, the manufacturing processes have been undergoing evolutionary changes; these continuing developments mean that plant space has to be kept completely flexible. At least as important in designing these latest buildings was the necessity of solving the transportation problem. Raw materials are received and finished products shipped both by rail and by truck. The rail siding is a full story above surrounding streets. In general, the manufacturing process is conducted on one level, with raw materials, parts and products distributed by overhead conveyors. No process-generated heat or corrosion difficulties affected design of the new buildings; rather, design depended principally on space for warehousing, with the condition that its full future use

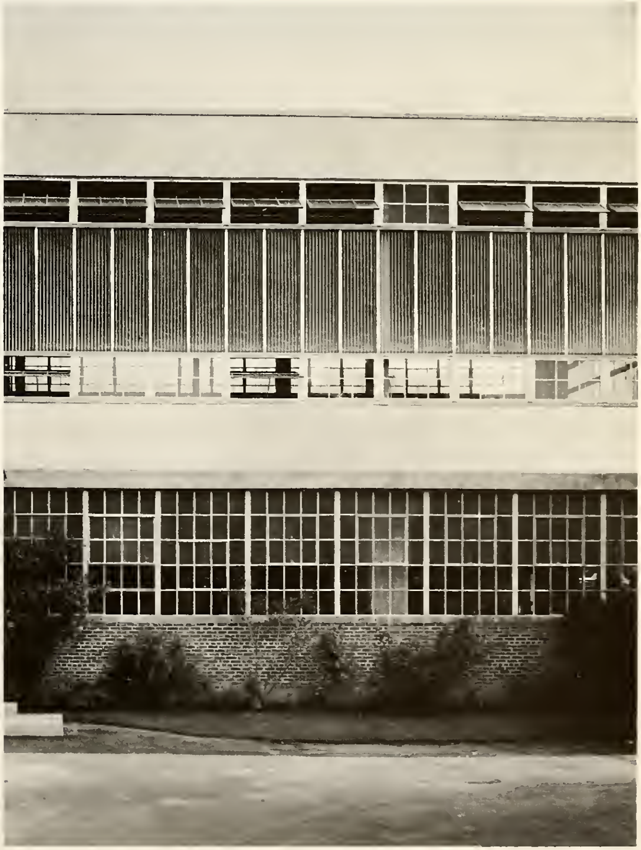
Paul Weidlinger
Structural Engineer

Morris Shapiro
Mechanical Engineer

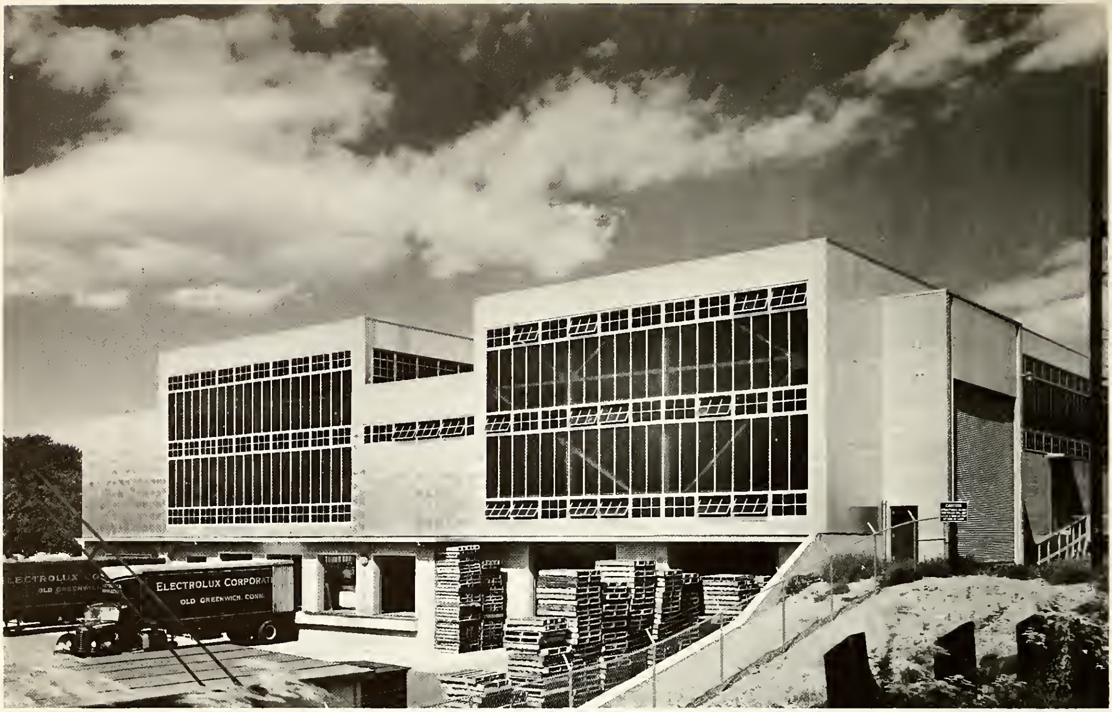
Claude R. Engle, Jr.
Electrical Engineer

Frank W. Binckley
Architect in Charge

Turner Construction Co.
General Contractors



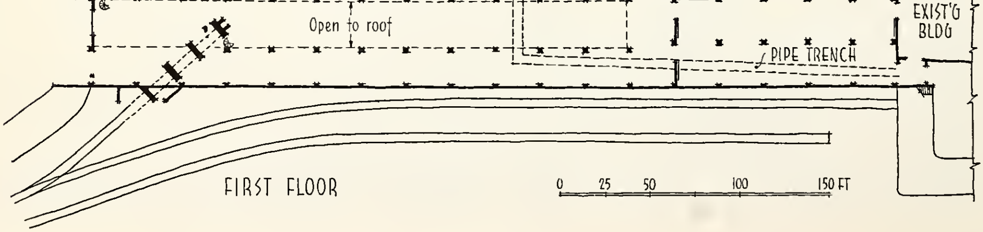
Facing page: top, north side of new building; bottom, air view showing new buildings at lower left, paralleling railroad siding. At right: detail, north facade

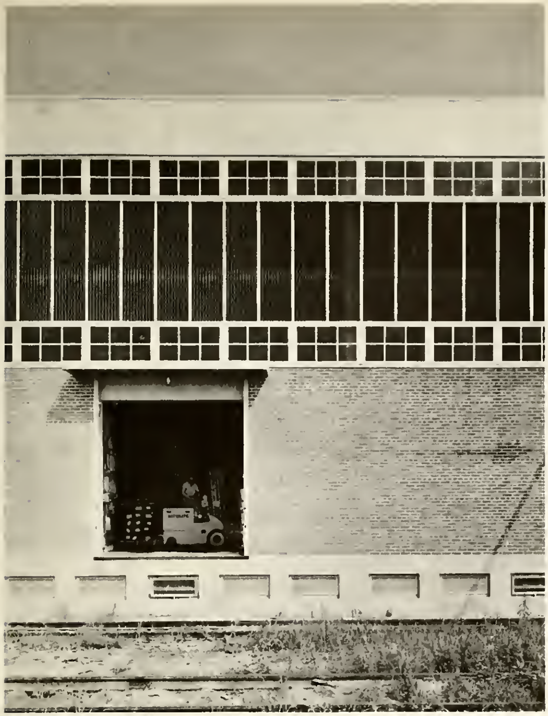


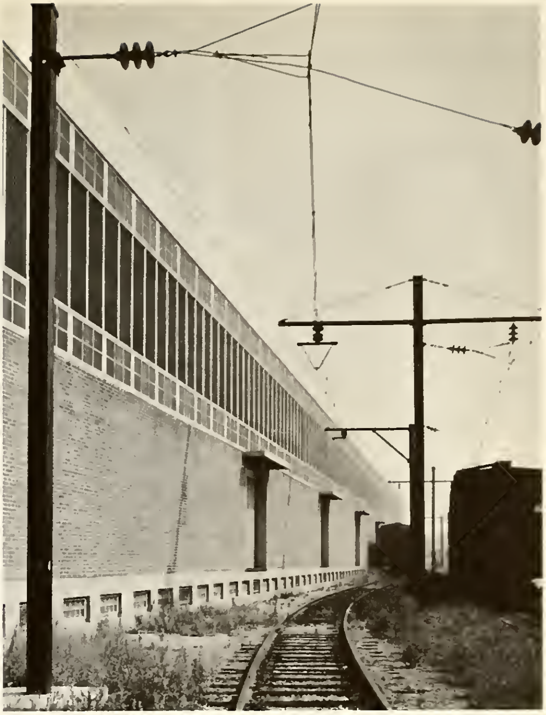
ELECTROLUX PLANT: *west end; note difference in level between railroad siding, at right, and truck docks, at left*

as manufacturing area should not be inhibited.

The new structures paralleling the railroad have their long axes running east and west. They not only increase the plant's warehousing and manufacturing space; by keeping the two types of shipping (rail and truck) on separate levels yet relating them vertically they reduce confusion to a minimum and achieve a substantial degree of coordination. Heavy shipments arriving by rail can be brought inside the building on a railroad trestle. Here they can be picked up by the 10-ton crane which travels full length of the south building and transferred to the mezzanine, or second floor, level; other shipments unloaded at the freight car-level doors can be similarly shifted; loads can be transferred to the first floor through the open well in the mezzanine under the crane runway. Both trucking entrance and existing



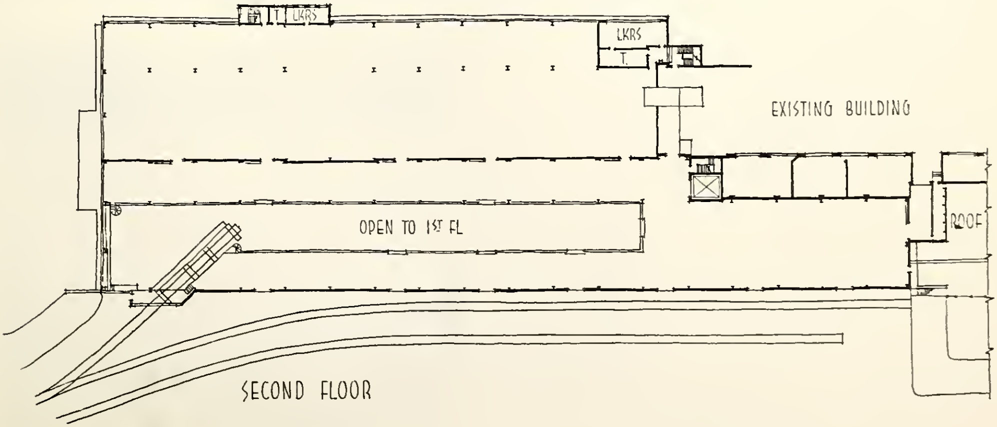




Joseph Molitor Photos

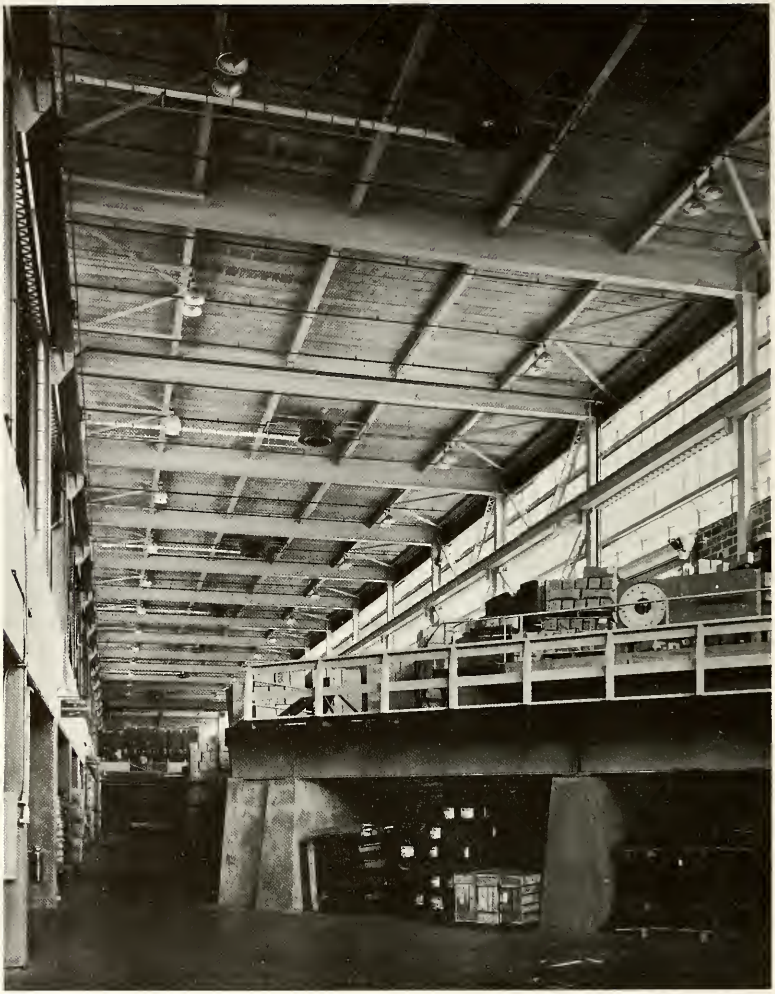
manufacturing areas are at the lower level. An automatic freight elevator also connects the two floors. A minor problem was designing the south building to be erected over a pipe-trench containing waste lines serving the entire plant.

Where walls are exposed to impact they are of concrete block and face brick; above that level they are insulated metal panels whose aluminum surface, clean and sparkling, was selected to minimize maintenance. Much of the wall area is glass: heat-absorbing and glare-reducing on the south and west sides, with large expanses of fixed corrugated wire glass in aluminum frames and horizontal bands of pivoted aluminum sash, motor-operated. The exterior is a careful composition of brilliant metal and blue glass, whose translucence indicates the high level of natural light within.

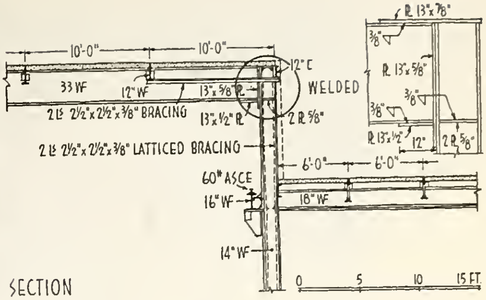


Up to mezzanine floor level this is a fireproof concrete structure; above that are curtain walls and roof with exposed steel frame. Before design was set, various framing systems were compared; studies eventually concentrated on roof trusses vs. rolled sections. Simple rolled sections (see photos and drawings) proved economical since additional initial cost was negligible in relation to total building cost and several advantages could be obtained through their use: for instance, overall exterior height could be kept within zoning requirements yet sufficient interior height could be attained for crane operation.

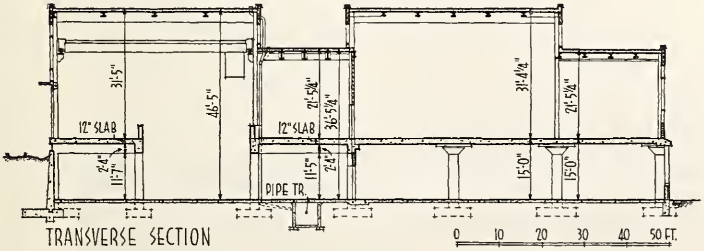
Light weight insulating concrete roof decking was similarly selected: its slightly higher cost per square foot was offset by possibility of wider joist spacing; and the material's acoustic properties, though not required by the owner, would enhance the building's use. In high bays, light rolled section joists were used; in low bays, where closer joist spacing was needed to attach conveyors and their equipment, open-web joists were found more economical



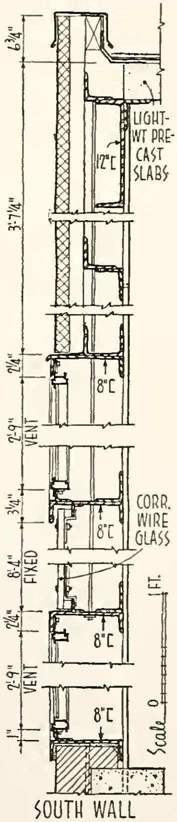
Joseph Molitor Photos



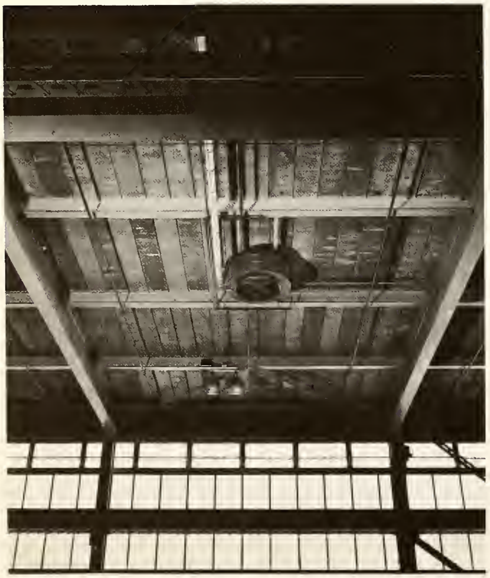
Detail at clerestory shows welded column-girder joint; roof bracing; rolled-section joists, widely spaced, over high bays; open-web joists over low bays where conveyors are supported. Below: section, sash and fixed corrugated wire glass in west wall

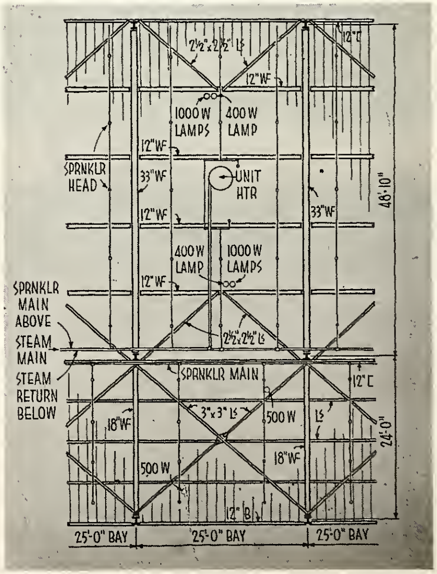


Steel columns and girders, with welded joints, form rigid frames. All other connections were bolted and riveted to accommodate the steel fabricators. Mezzanine floor has a 12-in slab to carry a design load of 500 lb per sq ft. In the east section, where the open crane-well interrupts continuity, a two-way beam and slab system is used; in the north section, a continuous flat slab on mushroom columns



Throughout the plant's design there is recognizable a conscious effort to coordinate functional planning and structural and mechanical elements. Structural details and the framing system as a whole are extremely simple and uncluttered, so that not only were the client's definitely stated requirements and the building's functions provided for; but also, a number of major and minor benefits could be obtained without additional cost. Another evidence of this design concept is contained in the mechanical installations, shown below in photo and diagram, in which the careful placement of unit heaters, bay lighting and electrical runs, sprinkler piping, etc., is in very apparent contrast to the oftentime expedient or haphazard erection of equipment. The benefits of this consistent design policy in regard to selecting and installing materials, structure and equipment include improved acoustical and thermal properties, low maintenance cost, elimination of clearance problems, and — equally important — that esthetic appeal which only a thoroughly "clean" building affords.

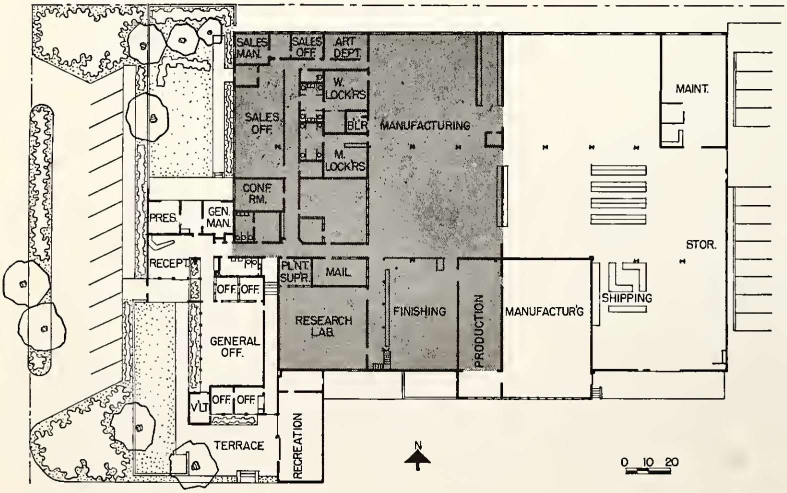




Joseph Molitor Photos

AMENITY VALUES

AMENITY VALUES" — a vague term for some pleasant plusses — are strongly developed in this small factory and office building. Notice, in the photo above, the walled-in garden which protects executive offices from street noises and confusion, also from dirt. There is also the pleasant entrance garden, with glass-walled reception space, with displays and planting tying indoors with outdoors. Employes have a large recreation room, with sliding glass panels opening to another garden; hiring offices open to this same terrace (see page 162). Costs for these "extras" could not be large.



The alteration adds office space to one side of an older building (shaded area in plan), more production space to the other. The garden walls tie old and new together, and help somewhat in the process of absorbing the old with the new. The architect expresses his conviction that "alterations which disregard the existing building . . . are as wrong as a zoot suit on Discobolus"

IN A SMALL FACTORY

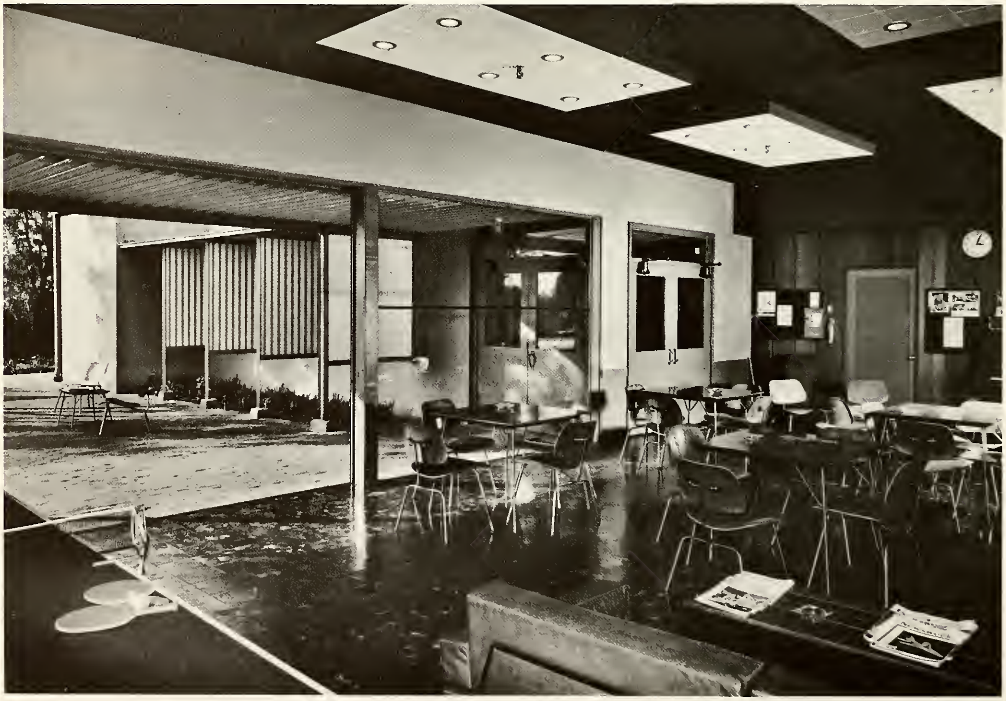
Additions to Plant of Avery Adhesive Label Corp.
Monrovia, Calif.
George Vernon Russell, Architect

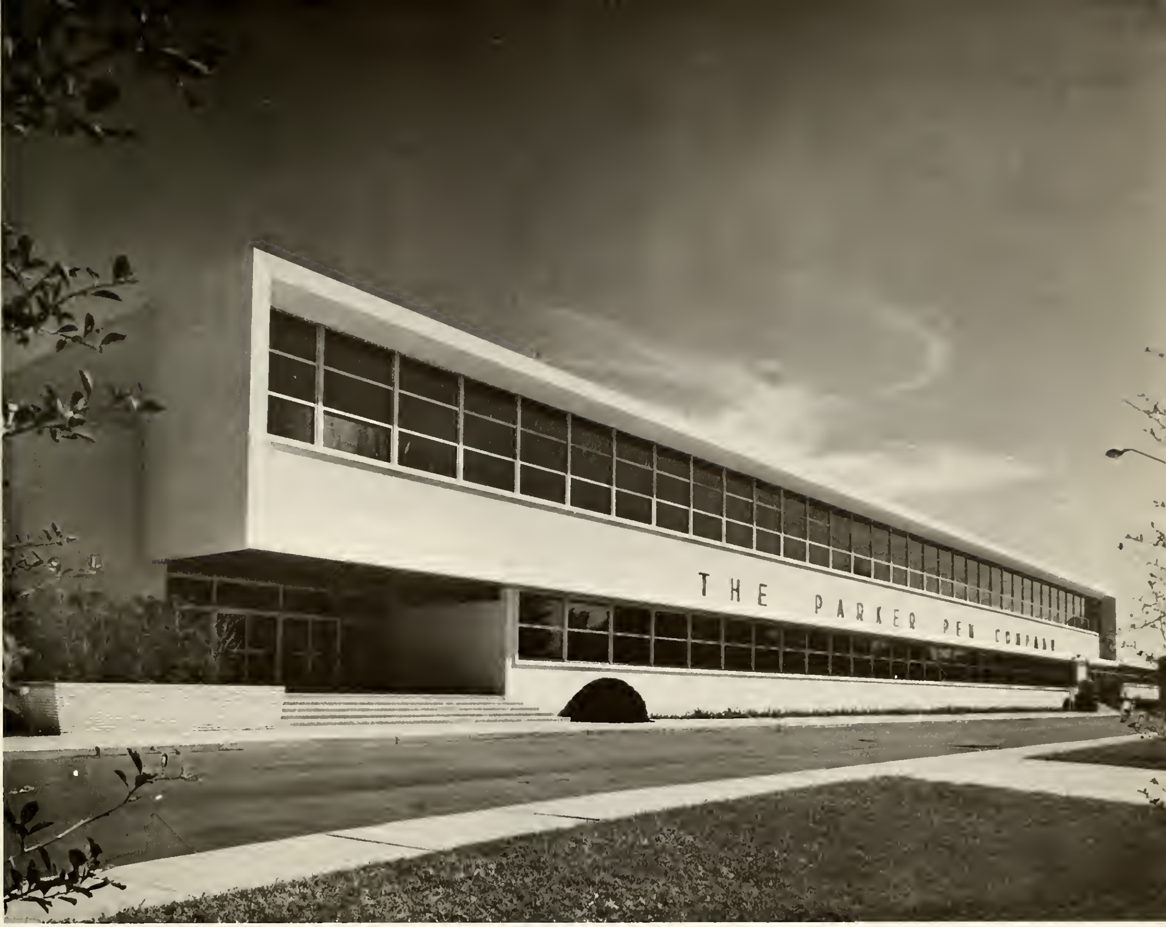
Julius Shulman

One can imagine that the strains of being a president are considerably eased by the pleasant outlook from this office (below, left). Production area (right, below) is well lighted and not crowded. Certain adhesive rooms are designed for minimizing possible blasts from volatile materials

Lunch time is a pleasant hour for employes in the room shown below. Large sliding glass panels open the room to the brick-paved terrace. Walls in this section of the building are of a tilt-up panel system largely developed by the architect, permitting continuous fenestration

Julius Shulman





William Wollin

FACTORY AND OFFICES WITH PRESTIGE VALUES

Plant for the Parker Pen Company, Janesville, Wisconsin

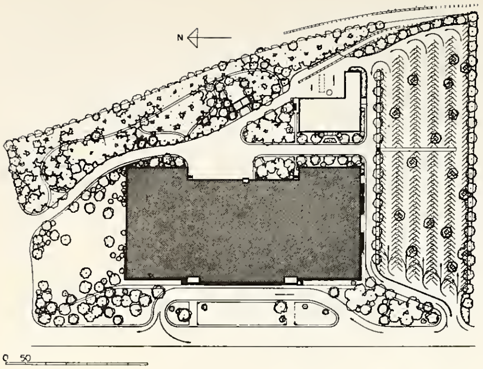
John J. Flad & Associates, Architects and Engineers

THIS BUILDING was already under construction when the architects were called in. They were asked to keep what they could of materials already ordered, of footings already in place, but they were to give the whole building an assertive institutional quality. The project had changed from one of merely enclosing manufacturing and office space to that of developing prestige values. Happily, this latter concept was not merely shirt-front thinking; substantial improvements were possible pretty much throughout the whole plant.

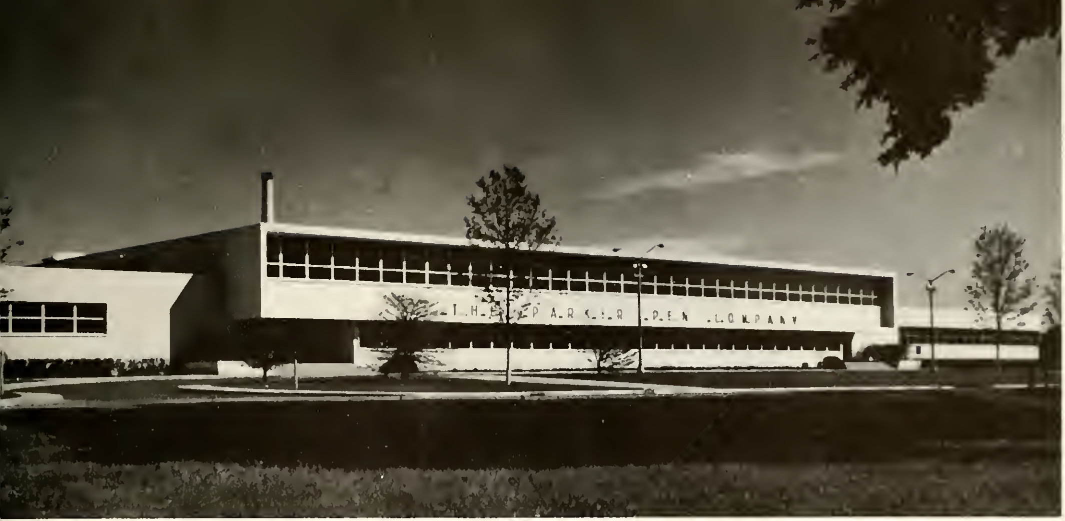
The entire plant has all-year air conditioning; air supply is filtered by electrostatic precipitators in the supply chamber. All exhaust air from polishing, buffing and grinding operations is filtered through separate precipitators and returned to the supply chamber.

The hand-faced white Roman brick (a dictated selection) is used on all exterior walls, in combination with white Texas limestone trim. All glazing is double thick, with heat absorbing plate on the exterior and diffusing glass on the interior. Ceilings throughout are of acoustical panels with glass insulation, with utilities plenum above the dropped ceiling.

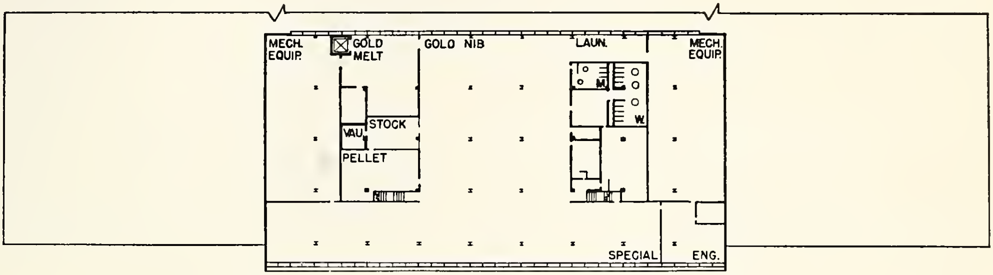
The cost of the building — offices and plant — was $4,500,000, exclusive of land, landscaping and fees.

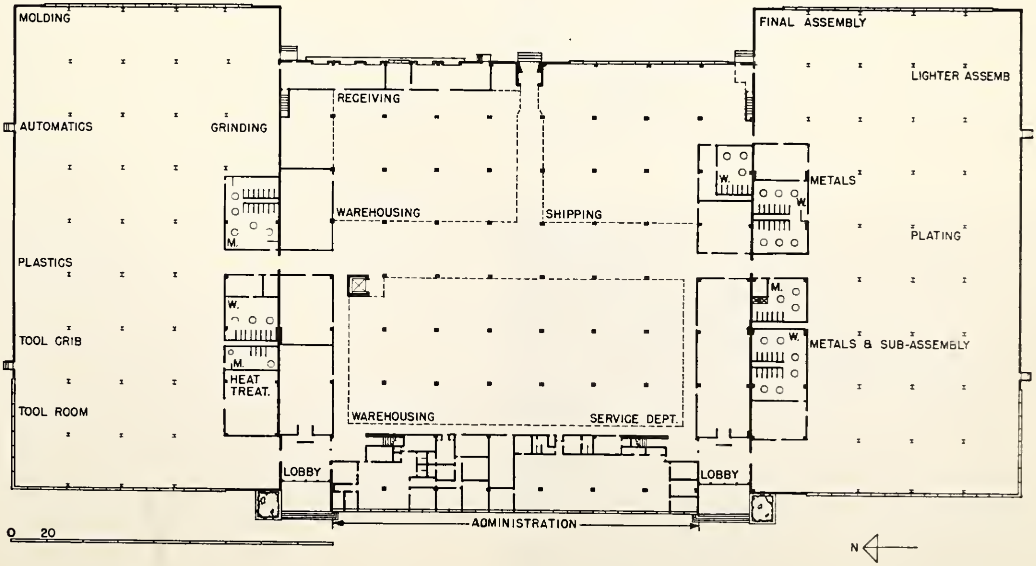


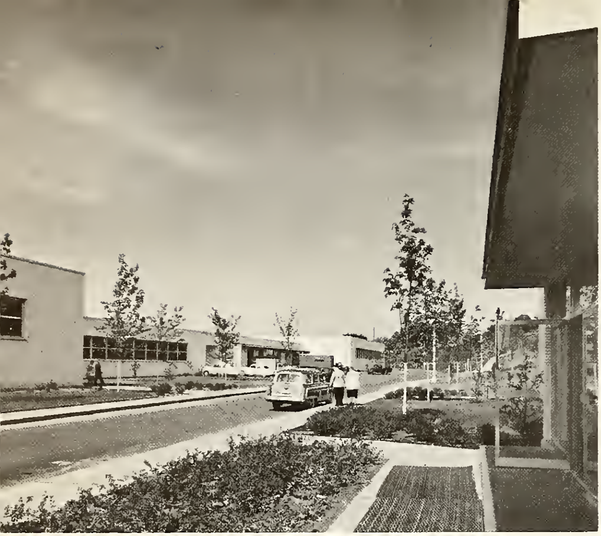
Service Building houses two 150 hp low-pressure boilers supplying steam for heating, air conditioning and processes; also one of three electrical sub-stations. Two smaller sub-stations (supply is at 12,470 volts) are located above the production floor in the plant itself. All lighting is recessed fluorescent. Flush mounted ceiling sprinklers protect the entire building from fire; there is a 150,000 gal underground reservoir to supplement the city water supply system

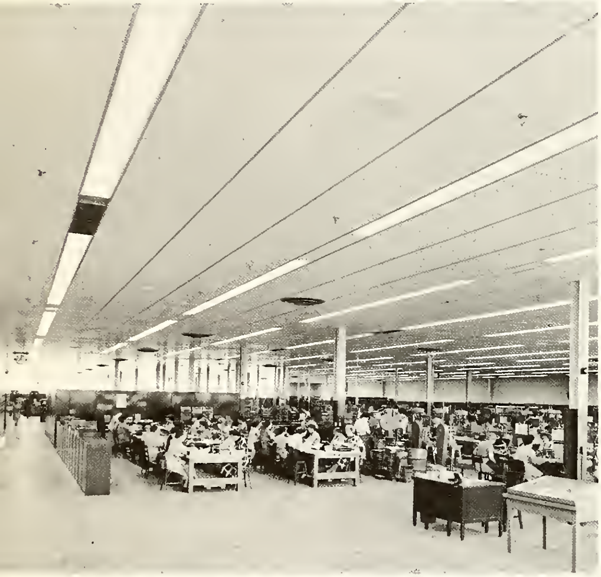


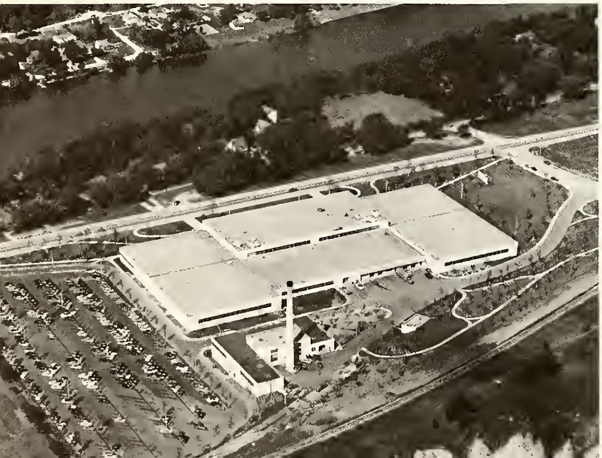
William Wollin











William Wollin

PARKER PEN COMPANY

The good-neighbor concept of industrial plant design extends to landscaping to the back as well as the front. The upper photograph shows the service road between main plant and service buildings, complete with trees, lawn and planting beds. Production areas are largely open; column spacing is 30 ft in both directions

SMALL FACTORY FOR A MOTORIZED AGE

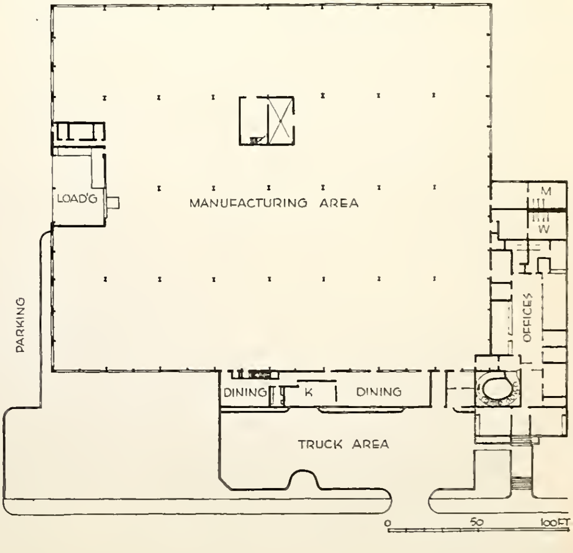
New Plant for Atlanta Envelope Company, Atlanta, Ga.

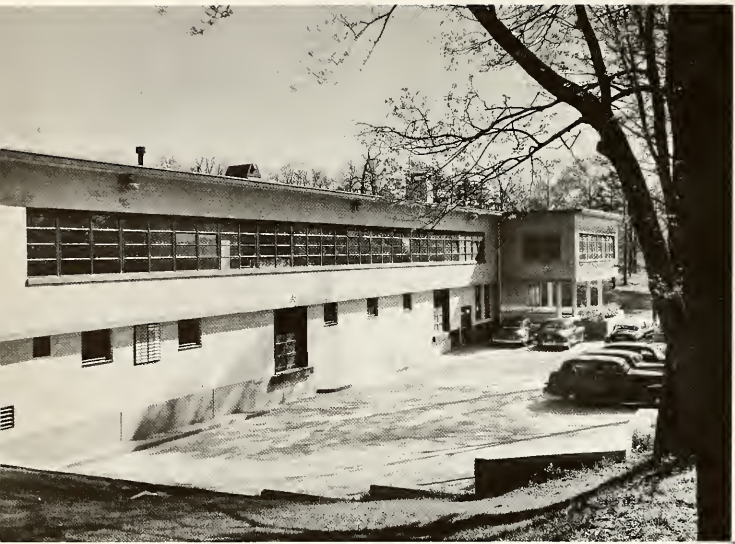
Moscowitz, Willner & Millkey, Architects

Typical of the small factory in a motorized age, this building pays its respects to the truck and the automobile. Its site was chosen on the main north and south highway through Atlanta, for easy access for truck deliveries, also to develop the advertising value of display to hordes of passing tourists. In addition, the site adjoins the clover leaf of a new expressway, permitting attractive landscaping and insuring an open area around the building. Although the plant is essentially a one-story scheme, advantage was taken of a slope to provide a lower floor for boiler room and scrap baling room. Separate chutes from machines above provide a very economical means of removing scrap paper, also of keeping it sorted by types. The two-level operation provides for deliveries at either level, to minimize handling costs. Parking areas are provided both at the rear on the main floor level and at the entrance at the lower level. Access for all personnel and the public is from the main entrance, from which an oval, cantilevered concrete ramp spirals up to the reception room on the main floor. This low-rise ramp was used instead of a stair and elevator which would otherwise have been necessary.

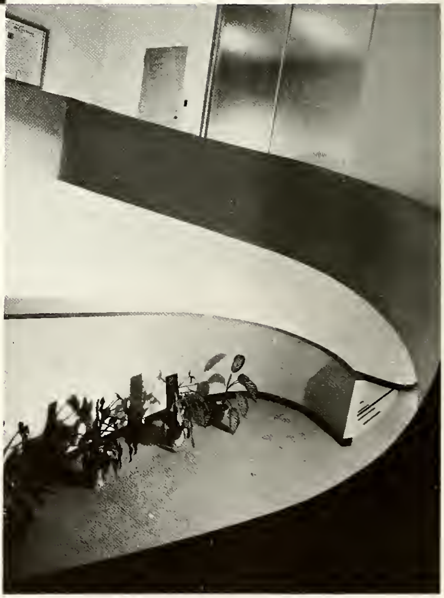
The building was designed around a circular flow chart for mass production of envelopes. Cantilever steel construction gave a 30- by 50-ft column spacing with a minimum of steel. The structural system uses the concrete floor as a structural element to stiffen exterior columns. Exterior walls are placed outside the exterior columns.

Joseph Molitor





All manufacturing is done at upper level; scrap paper is chuted down from individual machines, baled at lower level and taken away immediately by truck. Spiral ramp is public and personnel entrance to plant and offices from lower level; ramp takes the place of stairs and an elevator that would otherwise have been necessary. Office areas are air conditioned, air being exhausted from offices to cafeteria, which, being used only an hour and a half a day, does not then require its own cooling system



Joseph Molitor

Plant walls are buff structural tile exposed on the inside; in offices and toilets walls are light green structural glazed tile. Plant floors are concrete with a three-quarter-in. pea gravel hard topping; floors in office areas are asphalt and plastic tile

FACTORY DESIGNED AROUND MATERIALS HANDLING

New Plant for The Mennen Company, Morristown, N. J.

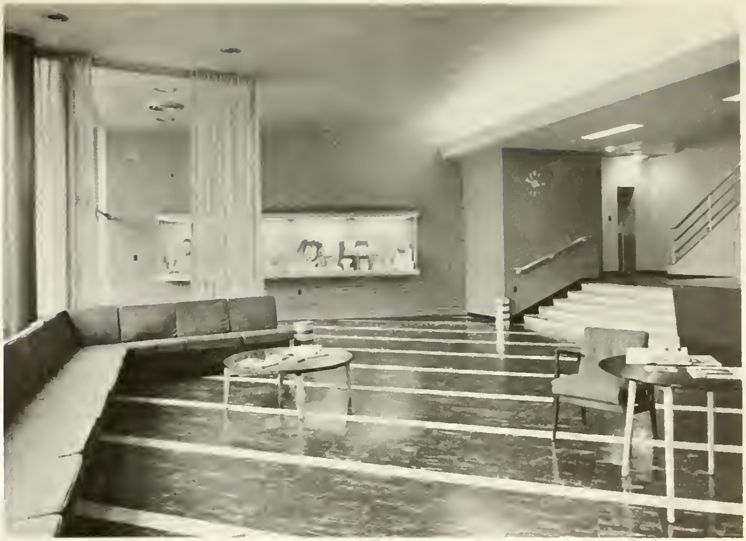
A. M. Kinney, Inc., Engineers and Architects

Materials handling efficiency was the central objective in the planning of this new factory; it did not actually take precedence over the manufacturing operation — for the plant introduces many innovations in producing its line of goods — but materials handling did affect the design of the building more than the manufacturing process. The packaging room became the heart of the layout, just as the final assembly line dominates in an automobile factory. Manufacturing is done on the second floor, since most of the ingredients are handled in piping systems. Virtually the whole first floor is warehouse and storage space, the packaging department at one end, the truck docks and railroad siding at the other. As a matter of fact, the huge warehouse area was the principal reason for the building of this new plant, materials and finished product storage having been literally crowded out of the old plant.

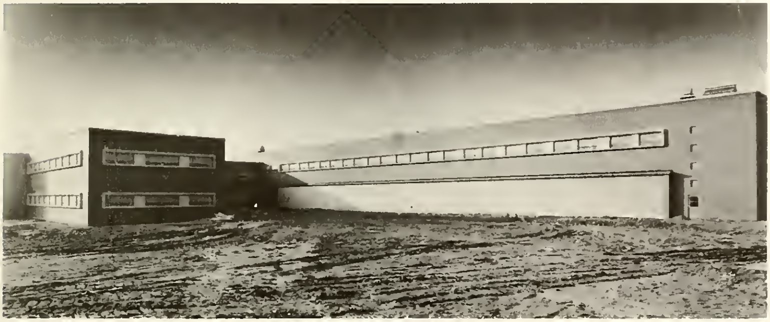
The spacious packing room is arranged across a portion of the north end of the warehouse. The exterior wall, having north light, is constructed entirely of glass block. The entire ceiling is louvered construction with fluorescent lighting above. After considerable study, the packaging lines were disposed in a U pattern, as this scheme greatly shortened trucking distances for packaging materials and finished cartons. The product itself is delivered to the lines by gravity flow from second floor. Thus there is virtually no trucking into the packaging room and it was possible to make it attractive with asphalt tile flooring in color patterns.

Bay sizes in the warehouse were selected to accommodate two sizes of pallets, 4 by 4 and 3 by 4 ft. Main aisles are 13 ft wide, cross aisles 10 ft, allowing ample maneuvering and passing space for fork lift trucks.

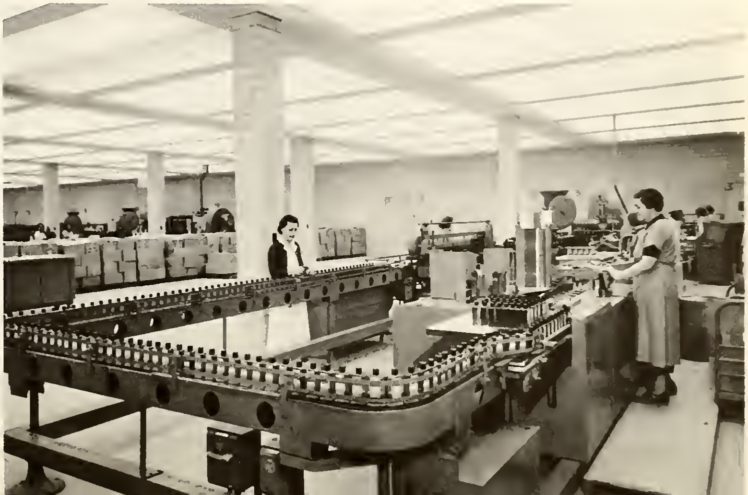
Materials handling equipment in the order make-up section was given considerable study, resulting in the rejection of some of the more complicated systems in favor of simple live roller belt conveyors, these continuing on outward to waiting freight cars or trucks.



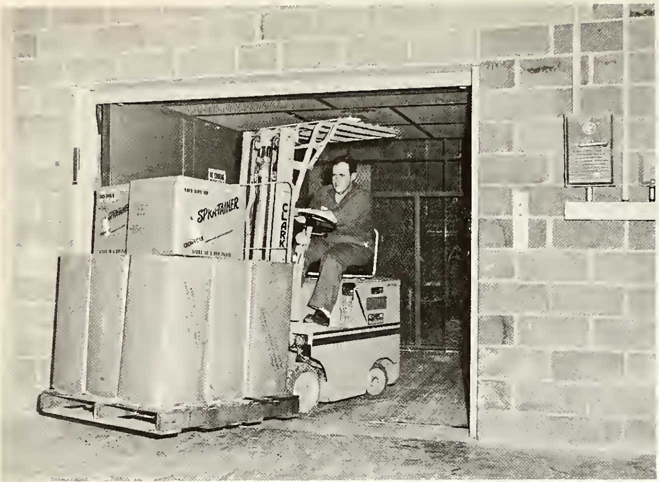
Administration building with its reception room (above) and offices is virtually a separate building at the front, will be given extensive landscaping



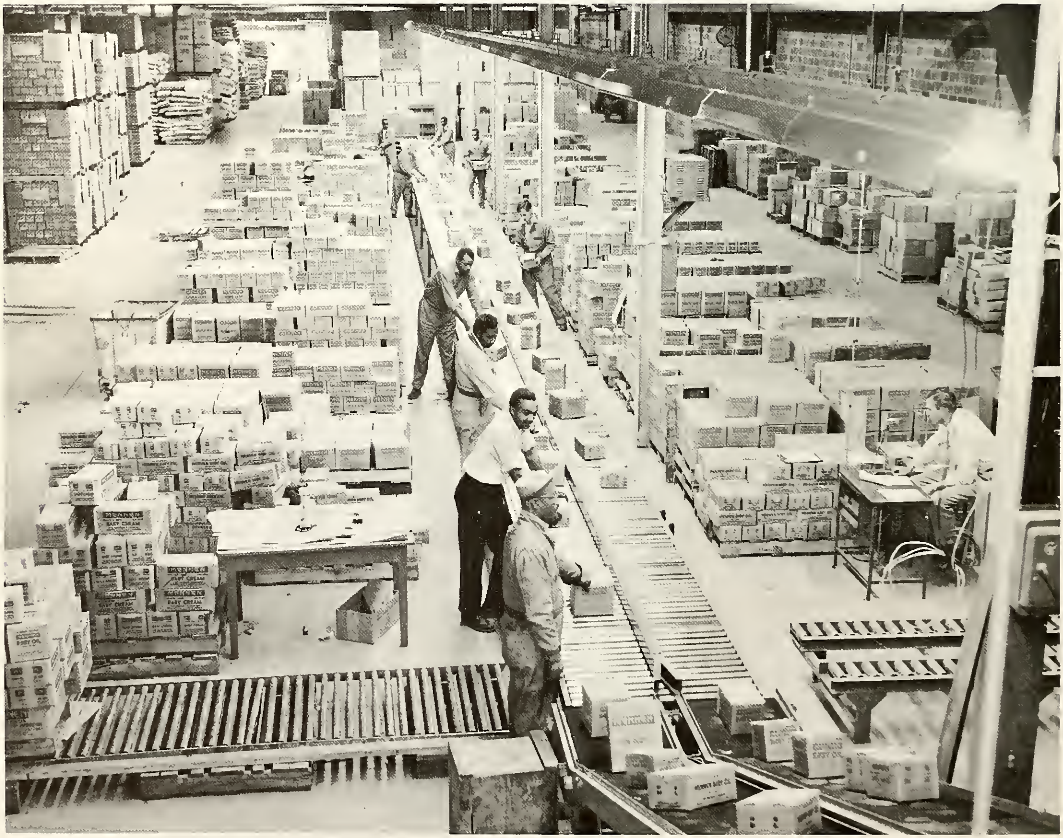
Packaging room (below), the "heart of the operation," has glass block wall at north side (photo above), louvered ceiling with fluorescent lighting above

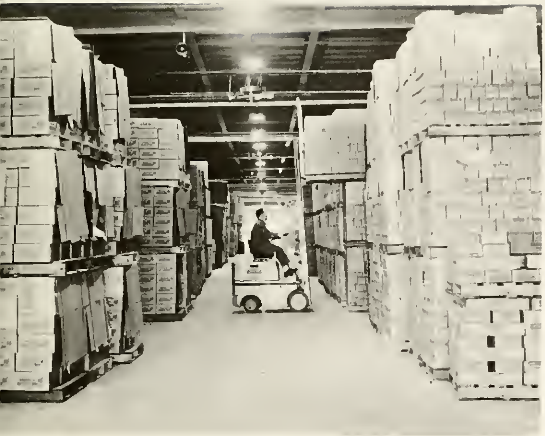


John Albert



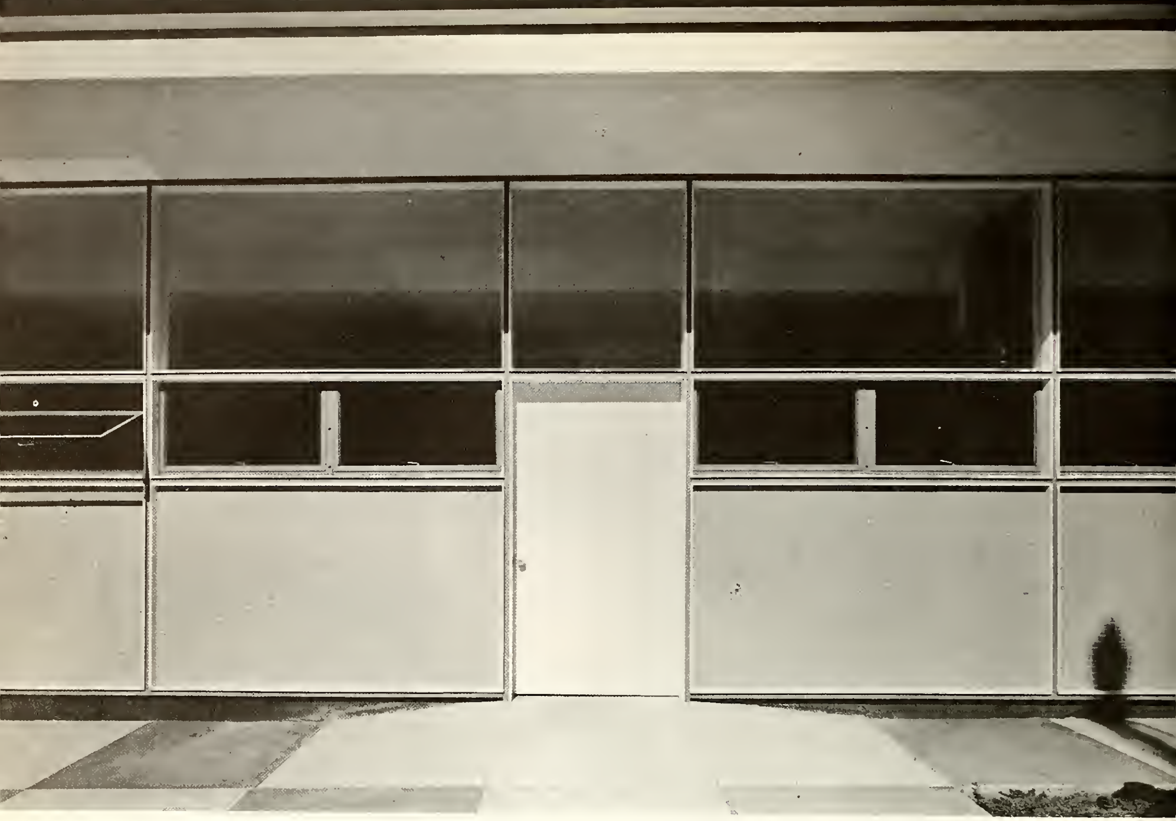
Only a few raw materials must be transported by truck to second floor manufacturing areas; for this a huge elevator can lift two trucks at once. Other materials can be piped up; finished products go to first floor packaging room by gravity flow. Making up outgoing orders is a highly systematized operation, but is handled on simple live-roller belt conveyors, which go on out to freight cars or trucks to simplify loading





Finished goods are stored in huge warehouse, with carefully arranged categories and aisles for palletized handling by fork lift trucks; thence they go through order make-up room by conveyors right into trucks

John Albert



BABY FORMULA FACTORY

Baby Formula Company
San Francisco, California
Falk & Booth, Architects and Engineers

A DYNAMIC ECONOMY, they tell us, is always developing new products; then sooner or later new buildings are needed for their manufacture. It must be so; this little building is convincing testimony. Started ten years ago with two part-time workers, this baby formula business now has its own building, complete with battery of sterilizers, conveyor system, running full blast 24 hours a day. What it means in architectural requirements: walls that could be steam cleaned, sterilized; a plant that need never be closed down for "repainting"; attractive clean appearance. This building is of load-bearing concrete block exterior walls, spanned by steel beams, non-load-bearing partitions. Wood ceiling joists and hung ceilings. Front is of unglazed ceramic tile panels set in wood frame, glare-reducing glass.

Roger Sturtevant

JOHNSON & JOHNSON TAKE A LARGER LOOK

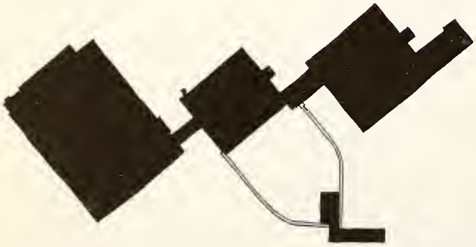
New Manufacturing Center
North Brunswick, New Jersey
Walter Kidde Constructors, Inc.,
Designers and Builders

When an industrial concern like Johnson & Johnson, famous in architectural circles for its enlightened concept of industrial buildings, changes its collective mind, that is news. And when the change produces so interesting a scheme as this particular project, the news seems worthy of attention.

For many years the growing group of factory buildings of J & J has been the subject of many presentations in architectural magazines, with glowing reports of high standards of design, functional efficiency, consideration for the welfare of workers, autonomy of individual enterprises, beautiful landscaping, large sites in decentralized locations, and so on. Most of these concepts they still hold valid, and will continue in the new manufacturing center at North Brunswick, N. J. Nevertheless the new center represents new thinking; if it does not change the old it adds substantially to it.

What it amounts to is that their building program was beginning to grow beyond its previous bounds. Expansion needs were coming faster than could have been anticipated; some still sparkling new plants could not be sufficiently expanded. Their large sites were not large enough. Their older buildings — especially the ancient group at New Brunswick — were forcing expensive operations of a shoe-horn nature. There were growing strains in management, production and distribution. It was time to take a larger look.

One of the theories that suffered in this process was decentralization. A small plant, in its own location, with its own autonomy, its own group of workers, its own proud building — this was all very nice up to the



point where the seams burst. Then most of those advantages were lost in another move.

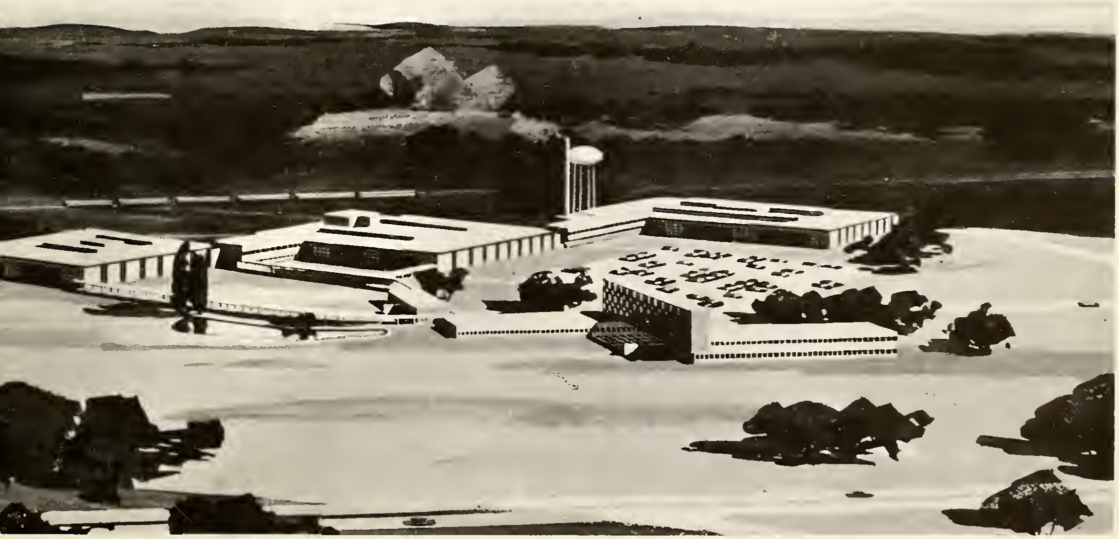
The new center will regroup certain of the manufacturing operations, and the shipping center, with a large enough site and a large enough concept to offer hope for some years of stability. It certainly does not represent the centralization of all J & J operations, far from it, but it may eventually become the home base, with new office buildings to replace the age-old home group at New Brunswick.

The rather radical grouping of buildings results from a similar rearrangement of thinking applied now to buildings. It did not arrive as a full-blown inspiration but grew laboriously out of months of effort to fit together many divergent processes and considerations. A few of the major changes in concept are shown in the diagrams on page 186, but it is reported that these are but a few out of dozens of tries. Those most active in this jigsaw puzzle process were: for J & J, C. V. Swank, Vice President, Manufacturing; L. J. Bardsley, Assistant to Vice President, Manufacturing; Nason Manley, Director of Construction Services; and for Walter Kidde, Frank L. Whitney, Vice President, and John Faas, Chief Mechanical Engineer. Whitney will be remembered as the project architect in charge of the Corn Products Refining plant at Corpus Christi, the one that is half-building-half-machine.

Here again the solution came out of thinking of buildings as machines. The diagrams illustrate quite graphically the mental switch required in this instance. The group started, not unnaturally, with a plan of A BUILDING, a building to house what they wanted to put in it. The idea of a single building seemed to offer so many logical advantages and economics (one big square building was obviously the least expensive) that a long time was spent trying to realize those benefits. Gradually it became apparent that the advantages were more theoretical than real. There were always compromises involved in just staying within building walls.

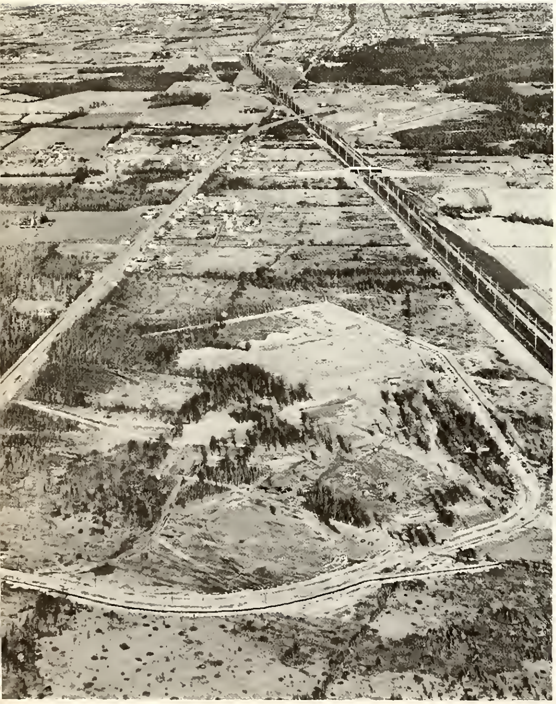
Suppose we think of this, they then decided, not as a building but as a theoretical layout of processes on a limitless site without any walls. Now move toward an ideal scheme, working out all systems of handling materials and finished goods, all similar considerations, then see where you want the walls. Now start drawing walls, roads, spur lines, all the rest. Now what do you have? Then double all the operations; where would the walls go then?

Stripped thus of all practical problems and sketched out as a theoretical approach, it all seems much easier to comprehend, and the switch in thinking doesn't seem too radical. Industrial architects generally report, however, that complications usually are so many, so real, as frequently to block this basic kind of total planning. It is indeed the conventional idea that all sorts of manufacturing operations are stuffed into one building shell. All manner of process engineers will work out their mazes of machines, pipes, conveyors, wires, and almost always think in terms of putting them under one roof. And at some point the building is frozen by considerations that the architect may or may not be allowed to tinker with. Industrial problems range. for architects or



Site for the Johnson & Johnson manufacturing center is 275-acre tract in North Brunswick Township, N. J., lying between the main line of the Pennsylvania and U. S. Route 1. Initial program calls for three main buildings, two for manufacturing, one a shipping center, plus cafeteria and auditorium building. Another factory building may be added later, also possibly a new home office building. Present program totals 600,000 sq ft; largest single building, 285,000 sq ft; completion of initial group during 1957.

Fairchild Aerial Surveys



construction engineers, from those in which they are called upon to plan everything, including materials handling, to those in which they can plan nothing but the enclosing shell.

It is odd — still philosophizing — how difficult it is to assume much freedom of thinking about buildings for industrial purposes. Buildings are fixed, permanent fixtures, that take recognized shapes and styles and conform to fixed regulations. They acquire intangible qualities, maybe even an institutional sort of veneration. To a certain extent, of course, there are solid reasons why buildings are not junked like other parts of the assembly line. But it seems generally true that buildings are supposed to escape the rapid obsolescence that is so well accepted for machines. Certainly they will not escape obsolesence unless they are conceived with fullest possible freedom and imagination.

In the J & J instance the single-building scheme was given a thorough shakedown before it was abandoned. A more detailed story of factors involved is given with the diagrams, page 180. Oddly enough it was a materials handling development that broke the dam wide open. While testing various layout possibilities (in the single building) the planners were also studying routes for a dragline conveyor, a sort of all-purpose trolley line doing most of the intraplant railroading. When they began to think of separate buildings they realized that the dragline could just as well go any place as be confined with certain walls. It could go from one building to another, and back again, and the only extra expense would be in the length of the line. Time of handling was not a real factor: time would only be costly if factory personnel had to do the driving. If loaded trucks could ride the line unattended (and of course they always do) why bother about a little more time en route?

Now we are getting places. We can plan our in-process handling as we like, free from worries about bulk-distance calculations on either raw materials or finished goods. Now we can plan buildings as we really want them.

But one minute. What does this do to our building costs? Walls running all over the place!

The answer was easy enough — there was almost no difference. Outside walls were much longer, of course, but inside fire walls were virtually eliminated. And since there was little cost differential between inside fire walls and exterior walls, there was little to choose either way.

But one more minute. What about people? Are they all going to have to ride bicycles?

This question caused little more trouble. In the first place, it is not people but things that travel the longer distances. Most of the people stay at relatively fixed stations. In the second place, distances to cafeteria building proved to be little greater than from one end of a single building to the other. Perhaps more people will have to walk that distance, but they will probably like this walk, since the separate building set in the park surroundings should offer a pleasant interlude, more pleasant than eating within the manufacturing plant walls.

Now the advantages of separate buildings began to roll out rapidly:

1. Expansibility comes first. With the buildings placed as they now are, each operation can expand in two directions as occasion demands. This expansion can be independent of other operations, forces nothing to move out of its path. Moreover, expansion will be in the easiest directions, forcing no disturbance to machines already operating (see diagrams).
2. J & J favorite theory — autonomy of separate manufacturing divisions — is maintained automatically. This is a consideration for labor as well as for management.
3. Closely allied to autonomy is scale of operation, and this too applies to workers as well as management. The separate building scheme cuts scale to humanly comprehensible proportions.
4. Strictly factory office areas and control laboratories are kept out of manufacturing buildings; they are in the connecting links between buildings, close to operations but out of the way of future layout changes.
5. There is greater flexibility for scheduling incoming shipments of materials. Theoretically, with three separate spur lines, one to each building, it will be possible to eliminate raw stores space. Whether or not this is ever practically possible, the three spurs help.
6. At one point it was considered disadvantageous to separate raw stores areas, as J & J wanted to consolidate controls. But some study indicated that physical separation was a small factor in control, and that this was more than offset by better handling of materials to processing machines.
7. Last but not least — several separate buildings give much more opportunity for architectural expression. Architectural attractiveness, always insisted upon by General Johnson, is difficult enough with a group of flat buildings of great size, but what would one do with a great square pancake? Now there can be some compositional effects, some relief in size and height, some logic and purpose in fenestration, some chance for color, some scope for Labatut's landscaping (yet to come). Some chance now for what J & J always want, an industrial development to arouse feelings of pride in management, workers, and in fact the whole community.

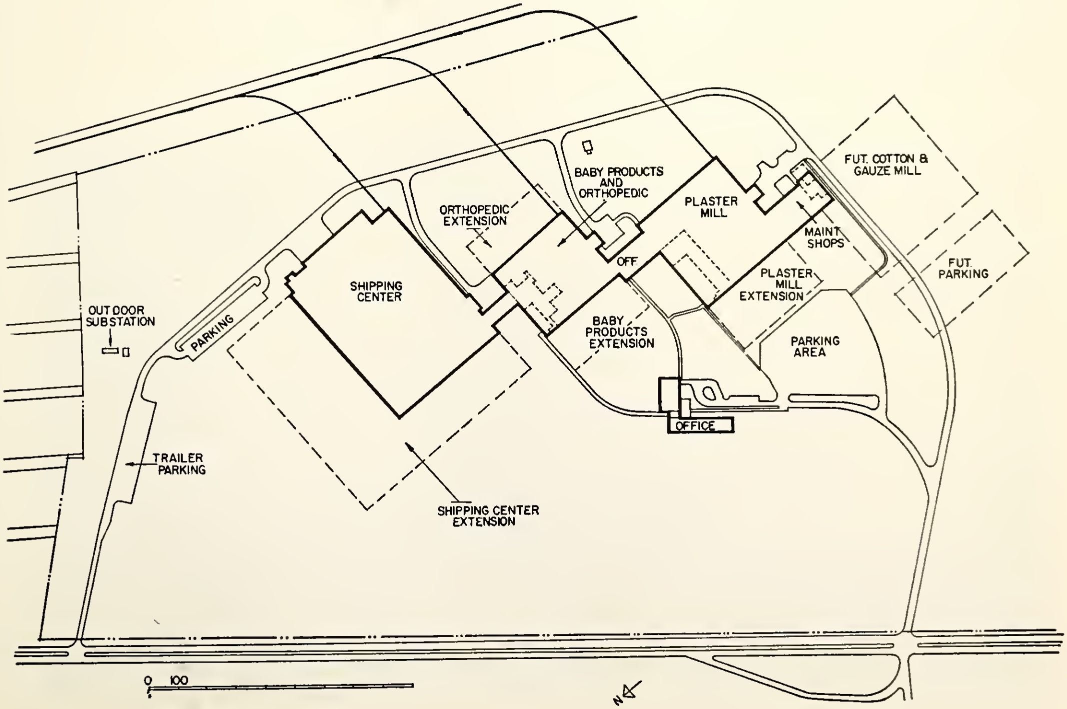


Figure 1 represents about the best that could be done with a single building, at about the time the Kidde men were called in. Expansion is obviously restricted; moreover any possible expansion would cause much moving, would be in wrong directions. J & J wanted incoming rail shipments to be so scheduled as to minimize storage and handling of raw stores, but a single spur line here would make that difficult.

Figure 2 shows an early try at separate buildings, with an attempt to centralize all raw stores. But handling of stores to manufacturing lines would be difficult. Expansion possibilities better but still by no means good.

Figure 3 is an attempt to keep raw stores together but also adjacent to manufacturing operations. But growth of stores area would be away from machines. Good freedom to expand manufacturing lines, but stores and machines growing apart. Single rail siding still a problem. An advantage in that stores areas are together, hence are flexible.

Figure 4 is getting close. Stores and machines are close together, and stores areas can grow parallel with manufacturing. Separate rail sidings now possible, but directions make sidings awkward.

Figure 5 is mission accomplished. It is same as Fig. 4 except that building layouts are turned 90 degrees to get rail spurs in easiest directions, and buildings are staggered to take logical positions on route of dragline conveyor which connects them all together.

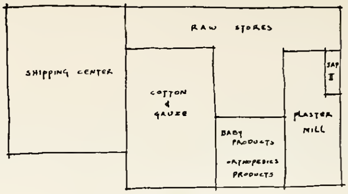


FIGURE 1

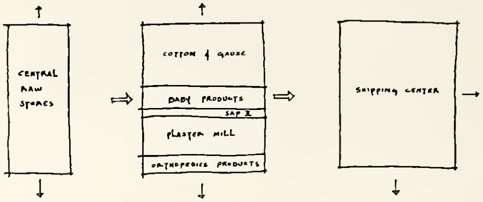


FIGURE 2

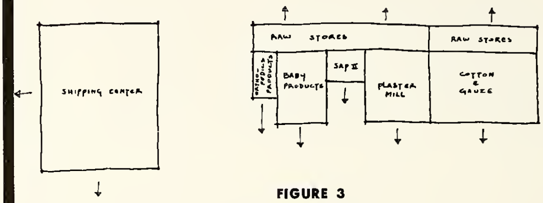


FIGURE 3

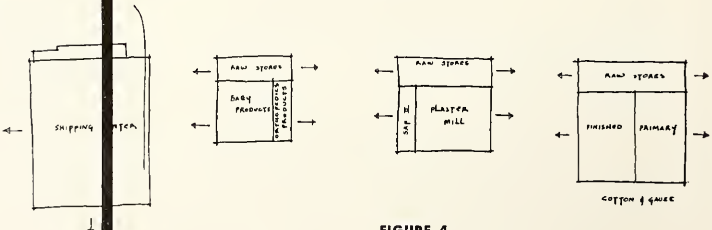


FIGURE 4

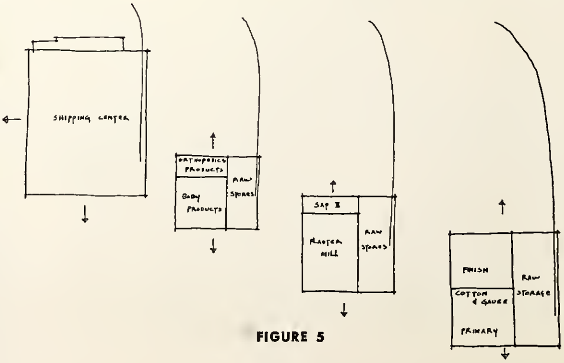
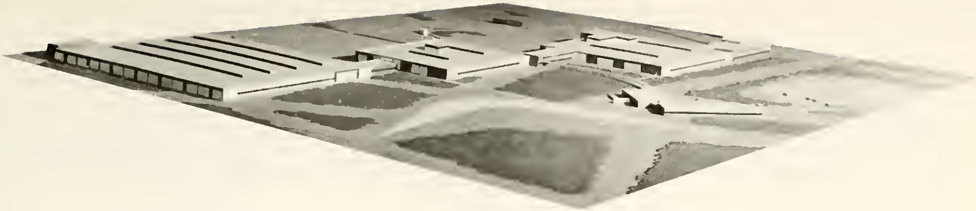


FIGURE 5



In this instance both client and architects agreed that fenestration should be rather intensively studied. J & J always wants daylight, not for lighting but for psychological effect. This desire even explains the monitors, though as a matter of fact the monitors proved very useful for enclosing a variety of vents and ducts that would otherwise clutter up the roof, and for fire-control vents. In any case, the architects took some pains over fenestration, as suggested by the elevations at the right. The sketched elevations are the final ones, the halftones the early studies of color effects.

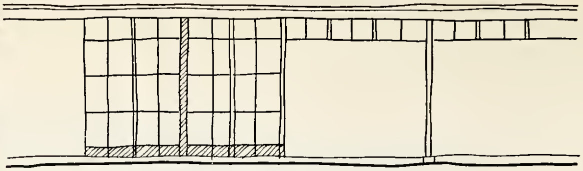
A blue glass will be used on all south, east and west exposures; clear glass on the north. West exposures use eye-level ribbon windows to obviate claustrophobia and to provide emergency ventilation. South walls will have ribbon sash below eaves for natural light and to allow maximum flexibility in locating louvers. East, ribbons under eaves and vertically alongside columns, enclosing blowout panels. North, ribbons under eaves plus occasional vertical strips for views and ventilation.

The buildings will be steel-frame, single-story structures, except for certain two-story office sections. Roof steel is of cantilever design. Walls generally will be of concrete block set between columns, with expansion joints at each column, making each bay essentially a panel. Walls will be generally white, with blue enamel cover plates over exposed steel girders and columns. Certain office portions will be of red glazed brick.

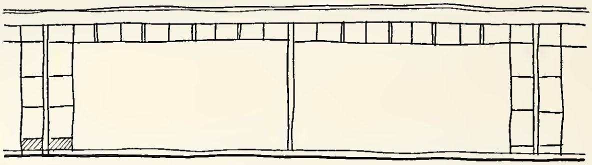
Column spacing is 41 by 41 ft, to accommodate ten rows of pallets. The clear height of the building is 18 ft minimum, with bottom of the steel set at 20 ft.

Each of the three major buildings contains its own administrative offices, lunchrooms, toilets, locker room and other personnel facilities, offices being mainly in connecting links between buildings. Manufacturing buildings will house employee facilities in basements, together with building services and processing equipment.

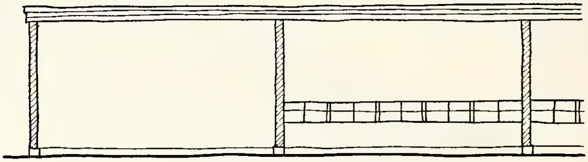
The center office and cafeteria group contains administrative offices, a central cafeteria and main conference or meeting room. Central medical facilities are also provided in this group.



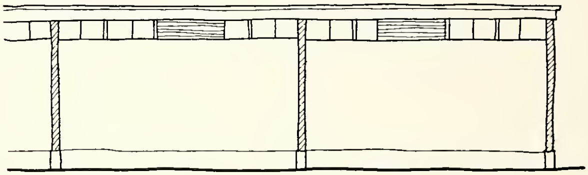
NORTH ELEVATION (FACTORY)



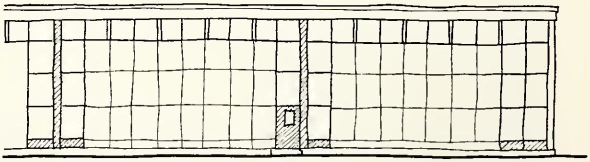
NORTH ELEVATION (SHIPPING CENTER)



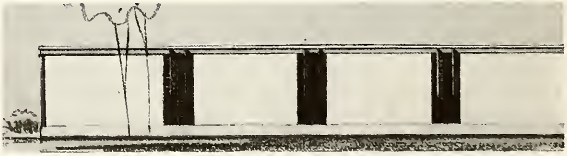
WEST ELEVATION

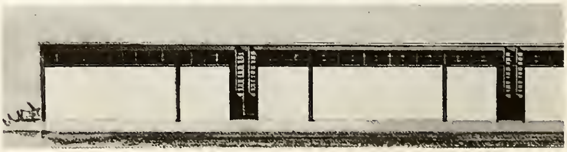


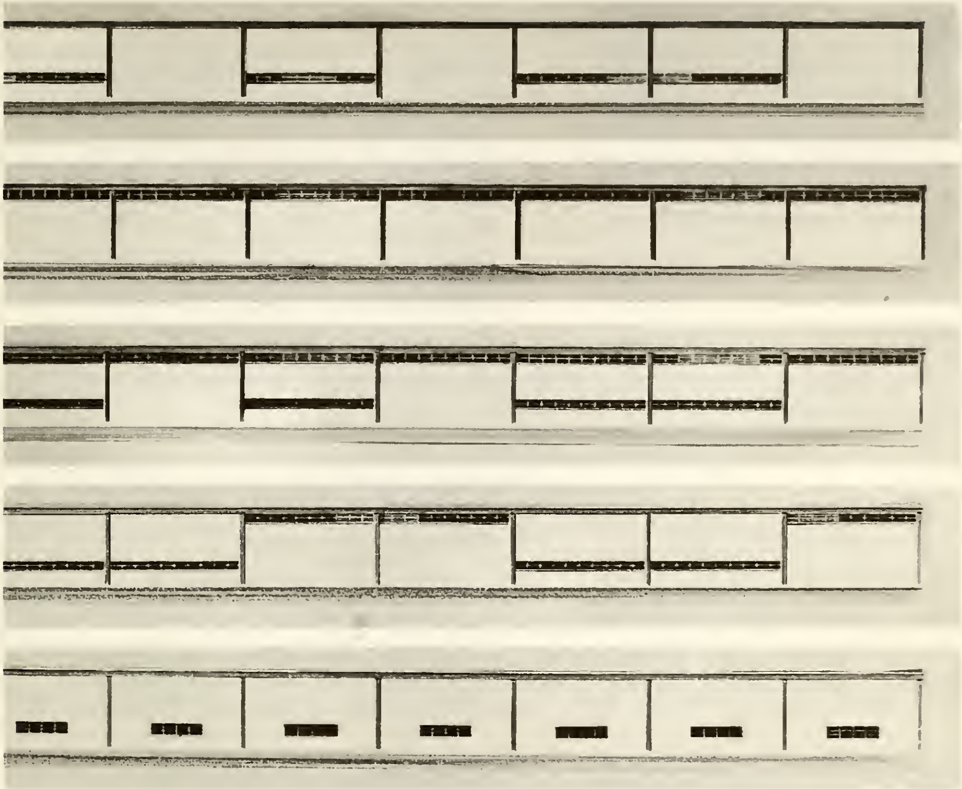
SOUTH ELEVATION (HIGH WINDOWS OVER RAILROAD SIDING)

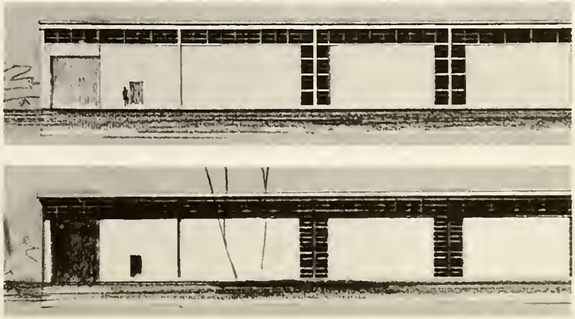


EAST ELEVATION (BLOW OUT PANELS)







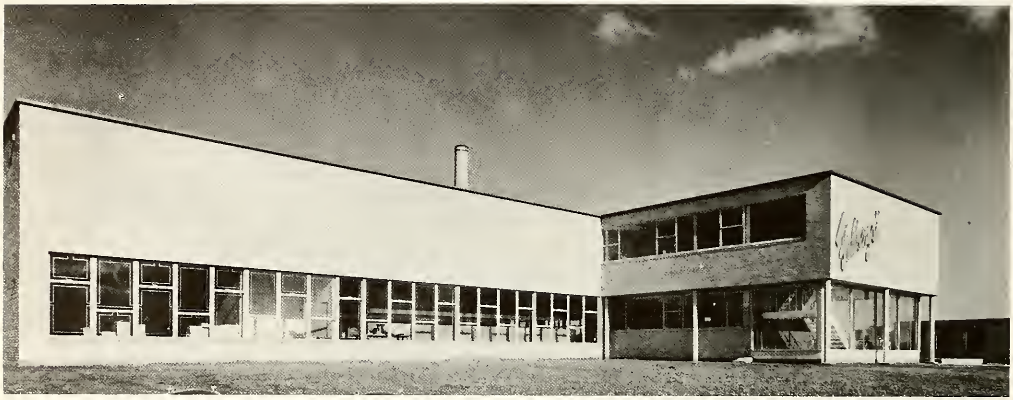


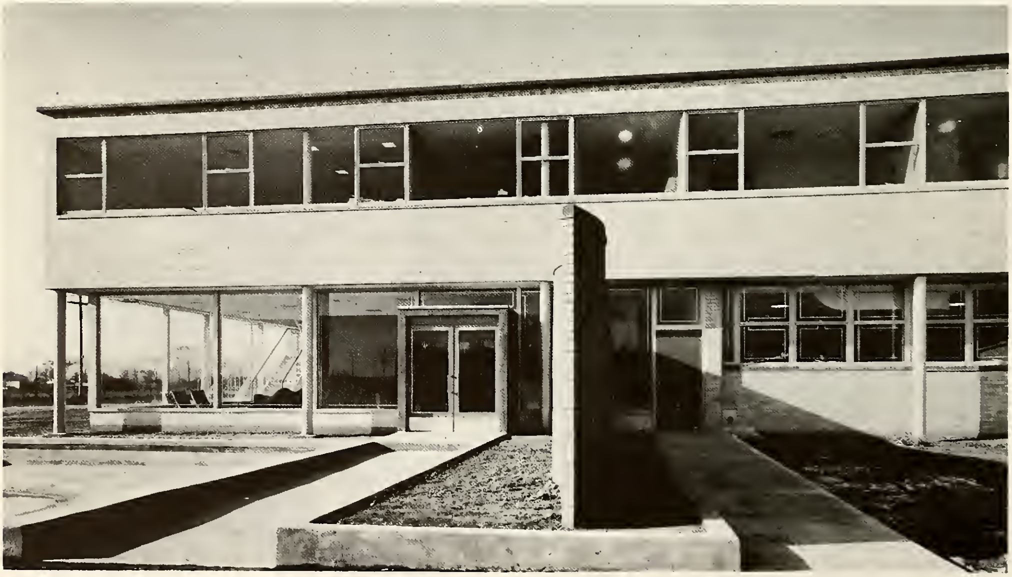
FACTORY AND SHOWROOM

Fabergé Perfumes (Canada) Ltd., Etobicoke, Ont.

John B. Parkin Associates, Architects

In another era a showroom would not be combined with a factory unless the location were in a downtown section, on routes well traveled by buyers. This one, however, is designed to attract retail representatives to an outlying location, on Queen Elizabeth Way, Etobicoke, Ontario. It provides full manufacturing facilities for perfume, cologne, and other cosmetics, complete employee facilities, and office and showrooms. A cosmetic showroom does not amount to much, measured in square feet, but it does call for a certain sales approach in design — reflecting pool at entrance, gardens (not in photos),serpentine wall separating main and employees' entrance, spacious lobby, general attention to display. Interiors are quite colorful.

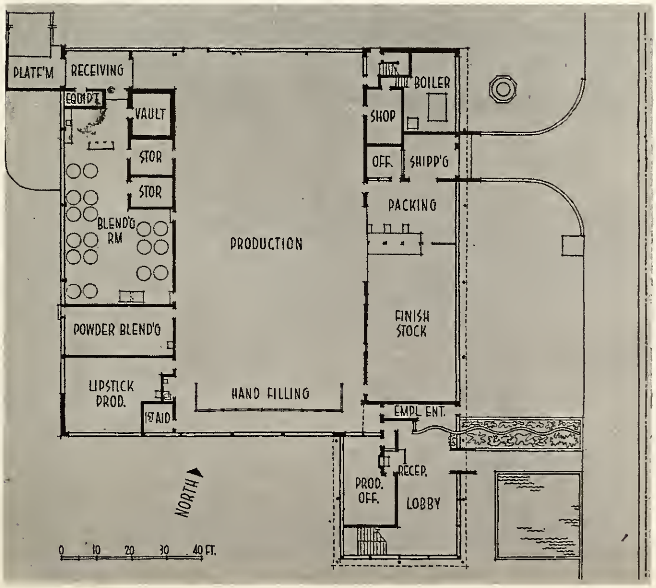


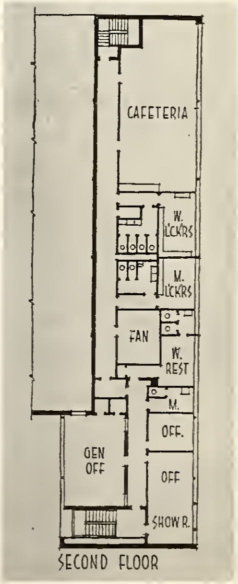


FOR PERFUMES

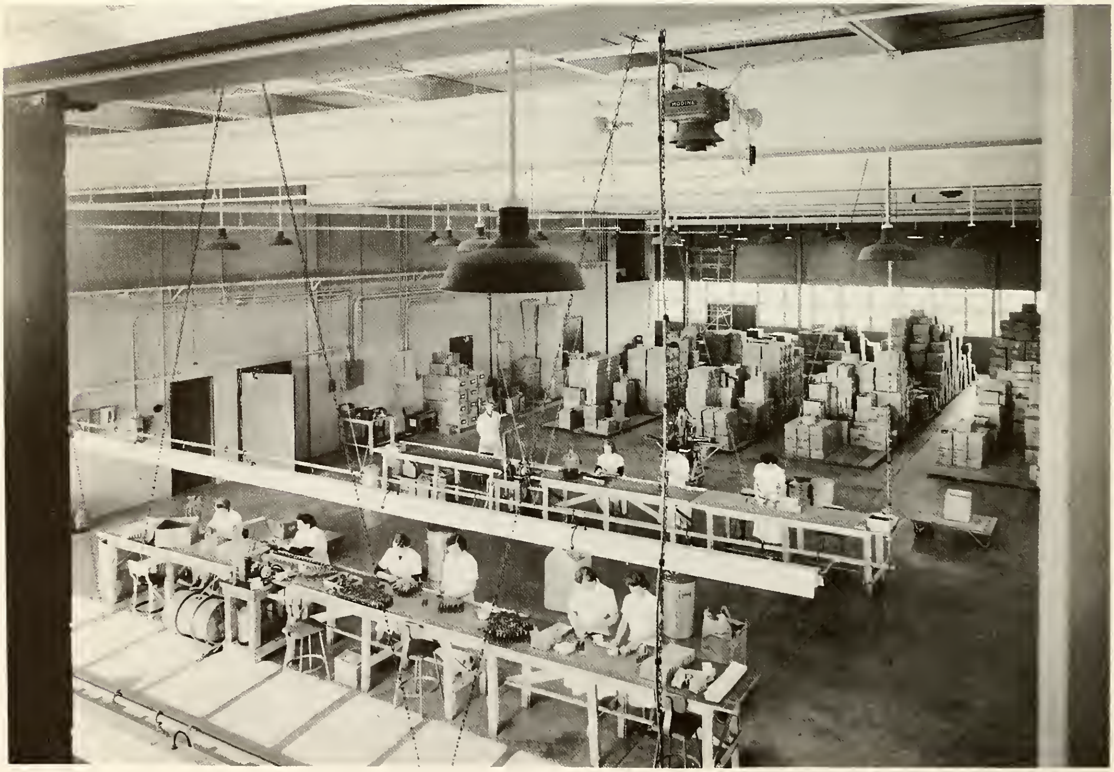
Photos: Panda

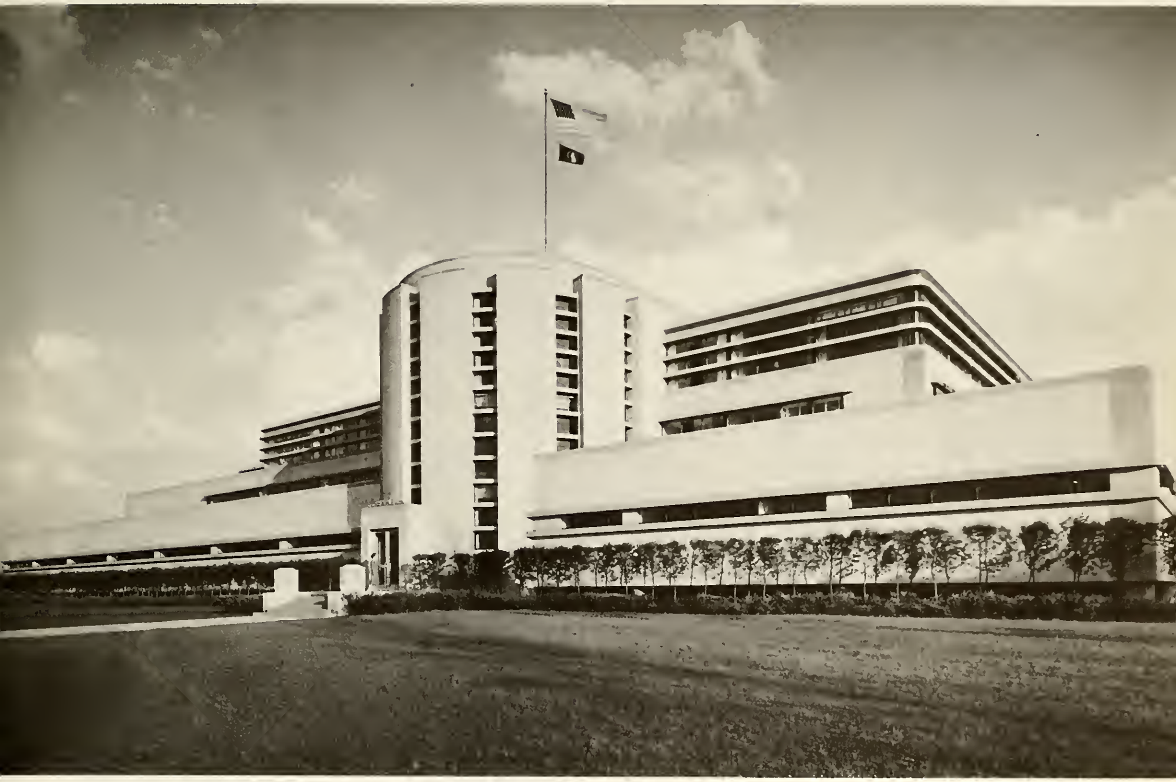
Main lobby, above and left, is unusually spacious, since this is showroom for Fabergé as well as factory Serpentine wall is continuation of one outside, separating entrances





Sales offices, even for cosmetics, manage to avoid the chi-chi effects in furniture and decoration usually associated with displays of feminine items. Main production area, below, has 60-ft clear span, bright colored walls, general and local lighting





Hedrich-Blessing

LABORATORY FOR MODERN MEDICINE

MANUFACTURING PLANT FOR G. D. SEARLE & CO., SKOKIE, ILLINOIS

HERBERT G. BANSE, ARCHITECT

GEORGE A. FULLER COMPANY, GENERAL CONTRACTORS

One of the last of the pre-priorities plants for private industry, this medical laboratory was completed just in time to aid in the vast contribution of medicine to the war. It was designed to reflect the great advances in medical science, particularly chemotherapy, to provide expansive and functional quarters for both manufacturing and research, and virtually ideal working conditions and recreational facilities for workers.

The lack of symmetry in the facade was no whim of the designer. Firstly, the building follows the dictates of function to an unusual degree, and the functions are highly diverse. Still more important perhaps was the unpredictable need for future expansion. Although the building allows for considerable expansion as it is, it was so planned and so placed that it could be extended without destroying the architectural design, as would be the case if it followed symmetrical lines.

The high first story is due in part to an "English-type" basement, partly to manufacturing requirements. This part of the building is in effect a windowless plant with win-

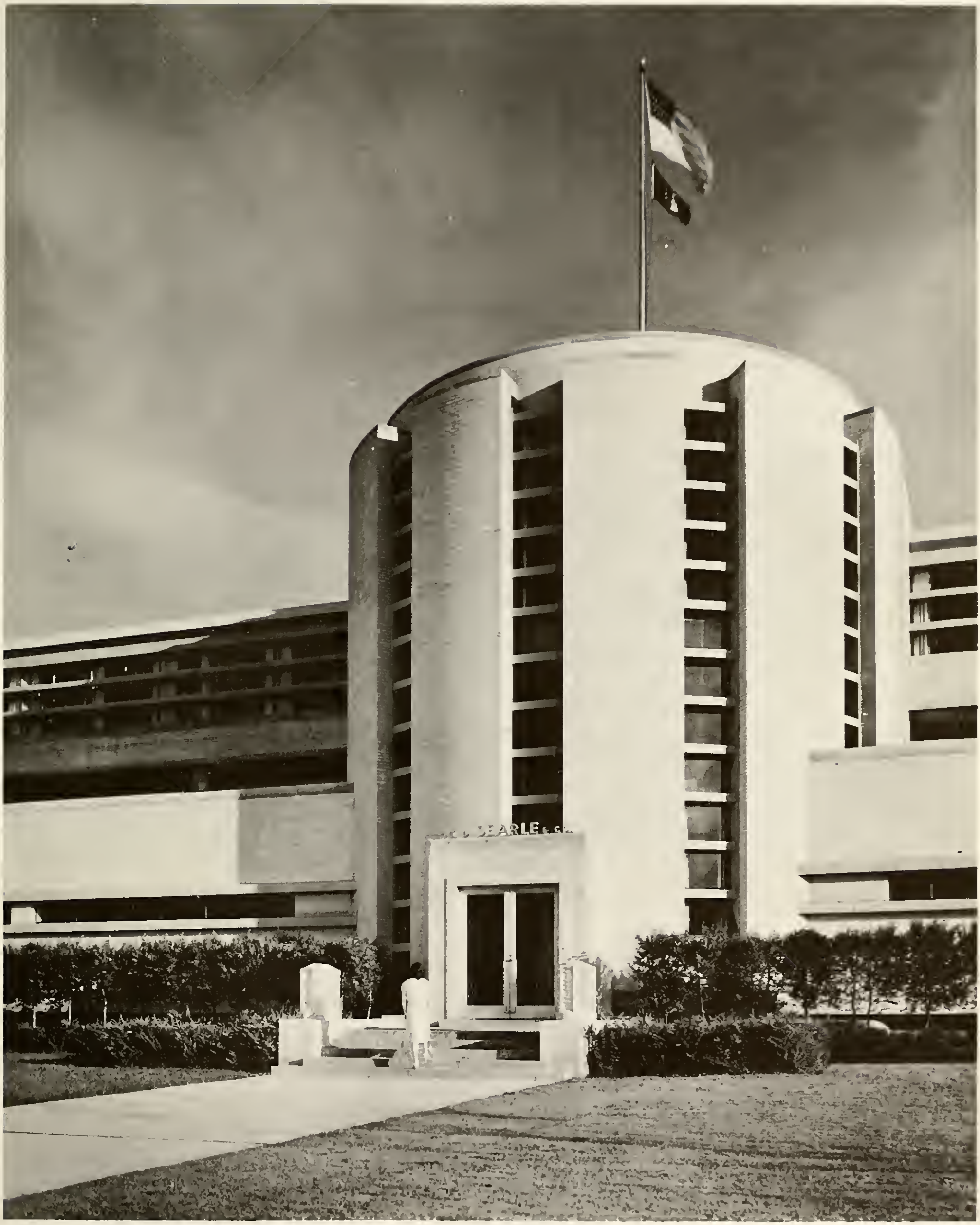
There is no whimsy in the lack of symmetry; this design will permit future expansion without greatly changing the exterior appearance

dows, hence the narrow horizontal band. The windows are only to permit employees to see out, not for lighting or ventilation.

Most of the building is completely air conditioned; the few remaining areas are heated by steam and mechanically ventilated. The air conditioning system was unusually complicated by varying requirements in manufacturing and other areas. In certain places fume exhausts are necessary, in others there are dust collectors, and it is not possible to recirculate air. In other quarters the air is irradiated by ultraviolet bactericidal lamps. Lighting throughout the building is largely fluorescent.

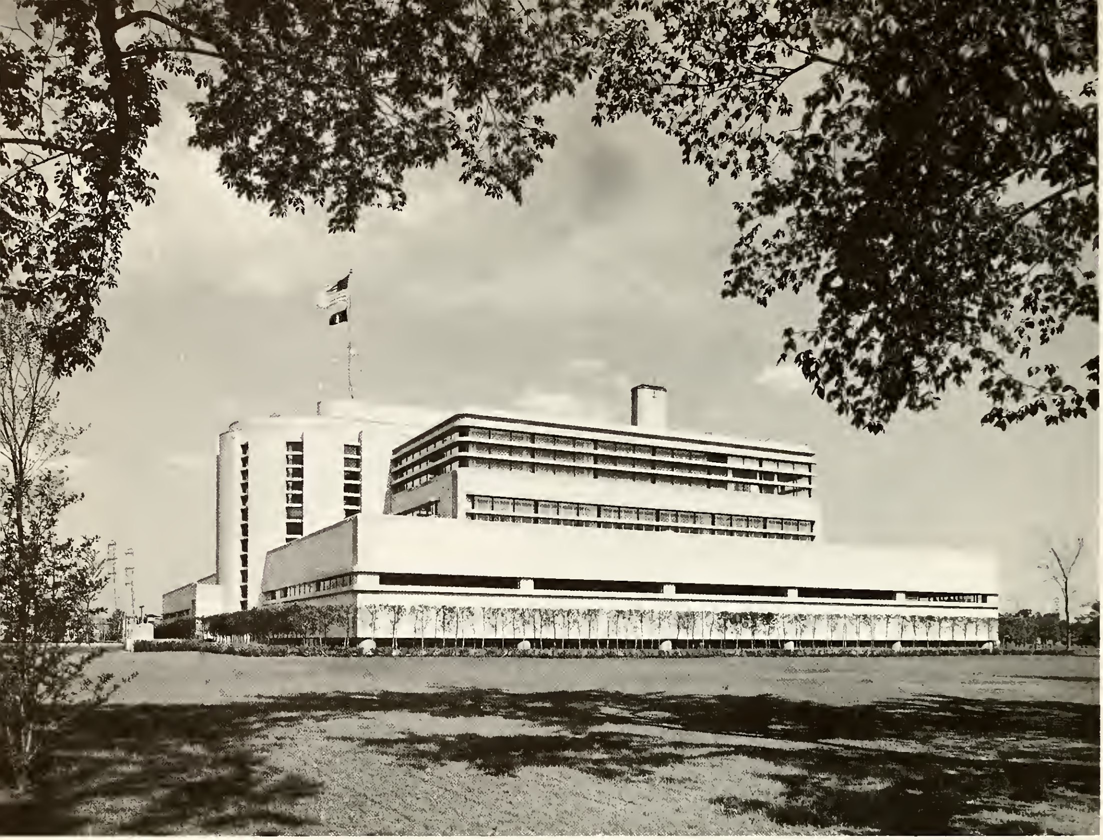
The unusual proportions of the first-floor warehouse space were calculated to simplify materials handling, as it permits storage of various chemicals and other materials near the production and packaging departments. This general scheme of storage is continued on the second floor, which is served by a freight elevator from the landing platforms. A combination of inner and outer loading platform doors prevents a rush of cold air in winter.

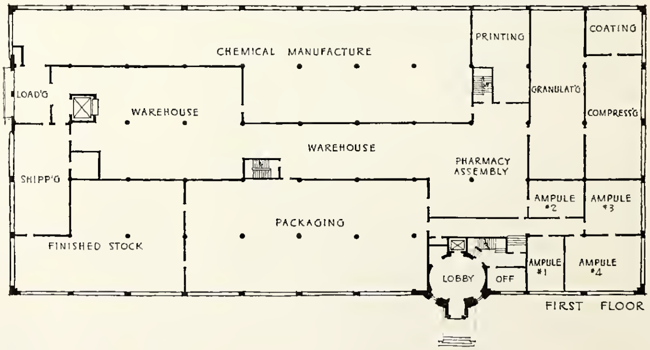
Rear view of the Searle Laboratory. The five-acre landscaped plot provides for expansion, and for recreational facilities for workers

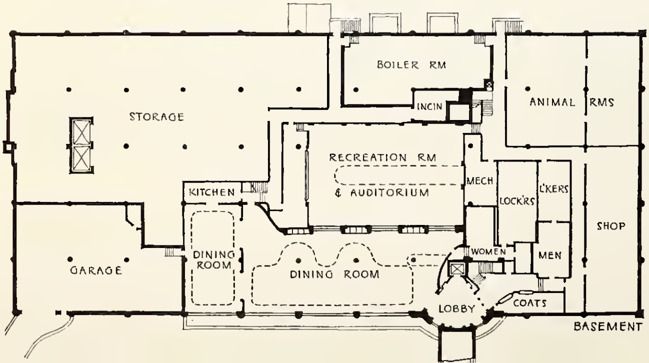


Hedrich-Blessing

Dominating the facade, this semi-circular tower section provides sumptuous lobby and reception rooms, with conference room above




CHEMICAL MANUFACTURE
PRINTING
COATING
LOAD'G
WAREHOUSE
GRANULAT'G
COMPRESS'G
WAREHOUSE
SHIPP'G
PHARMACY ASSEMBLY
AMPULE #2
AMPULE #3
PACKAGING
FINISHED STOCK
LOBBY
OFF
AMPULE #1
AMPULE #4
FIRST FLOOR


BOILER RM
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STORAGE
RECREATION RM
& AUDITORIUM
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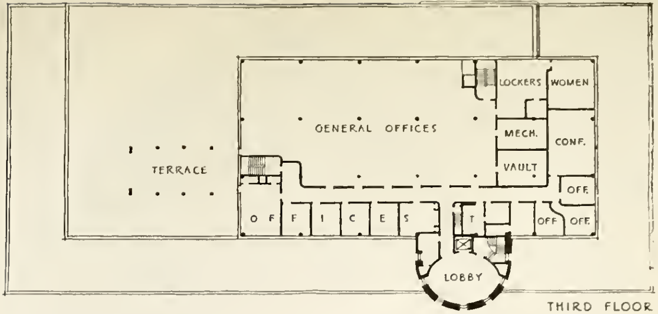
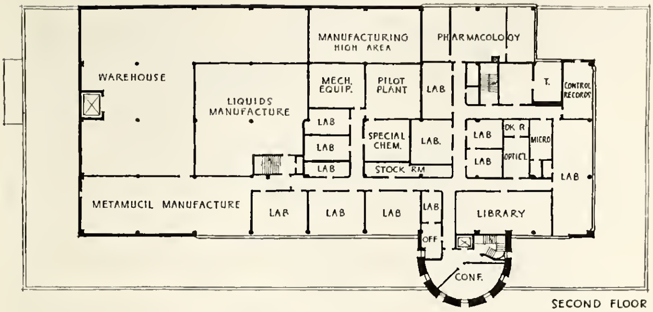
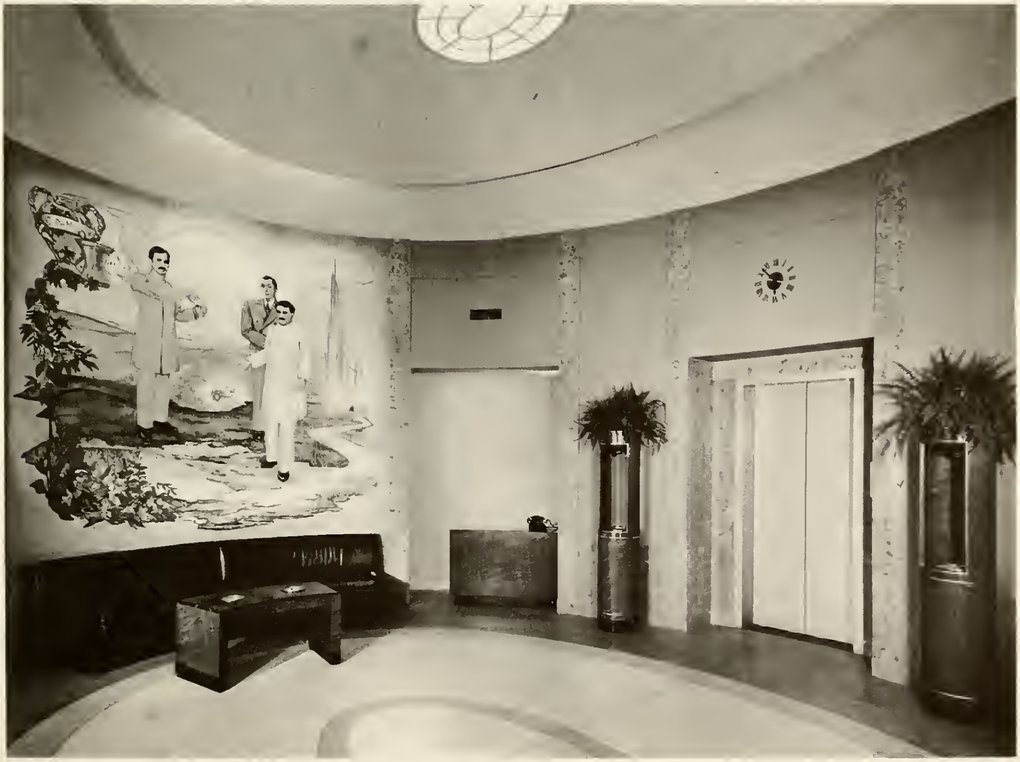
GARAGE
LOBBY
COATS
BASEMENT



THIRD FLOOR



SECOND FLOOR

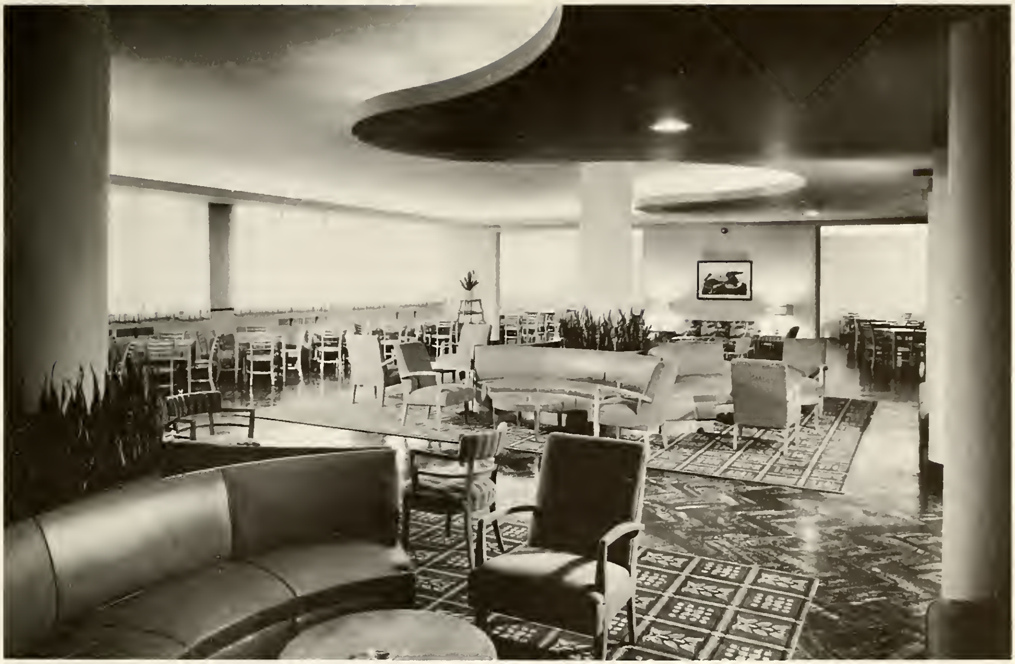


Entrance lobby on the main floor.

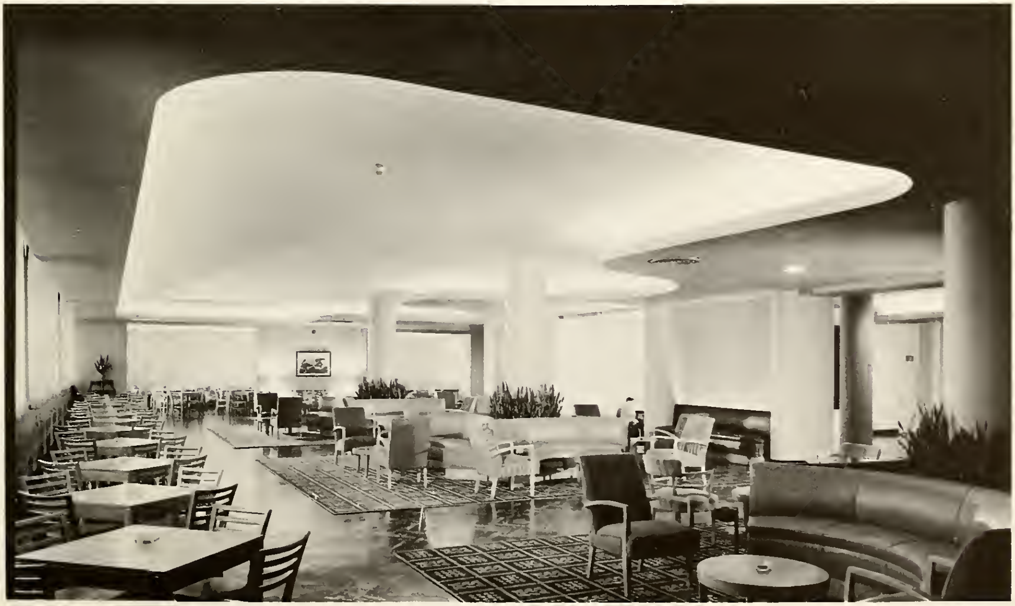
Hedrich-Blessing

Auditorium and recreational room in the basement, designed to accommodate a wide variety of meetings and employees' recreation

Entrance foyer to employees' lounge and auditorium. The display cabinets show Searle medical products in various stages of manufacture



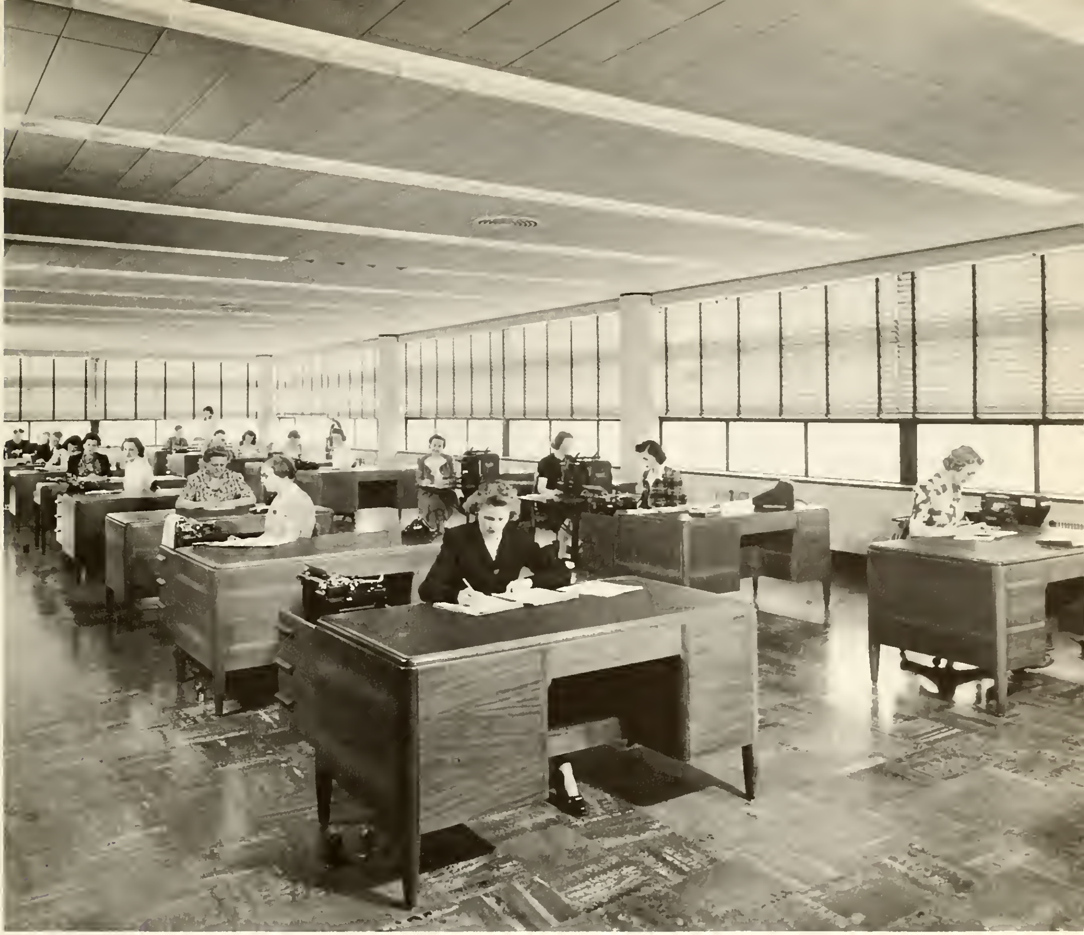
Two views of the extensive lounge and dining area. A kitchen is provided for serving special parties, not for regular meals



Hedrich-Blessing

The office of the president. Furnishings here, and most others throughout the building, were designed by Felicité Reynolds, Inc.

The scientific library, on the second floor, is easily accessible from the several laboratories and from elevator and main stairs



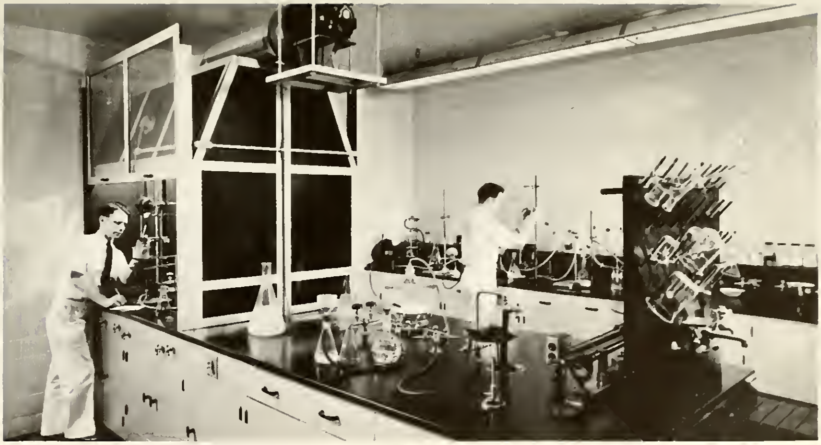
General office space on the third floor has full windows, fluorescent lighting, acoustical ceiling, asphalt tile floor, air conditioning

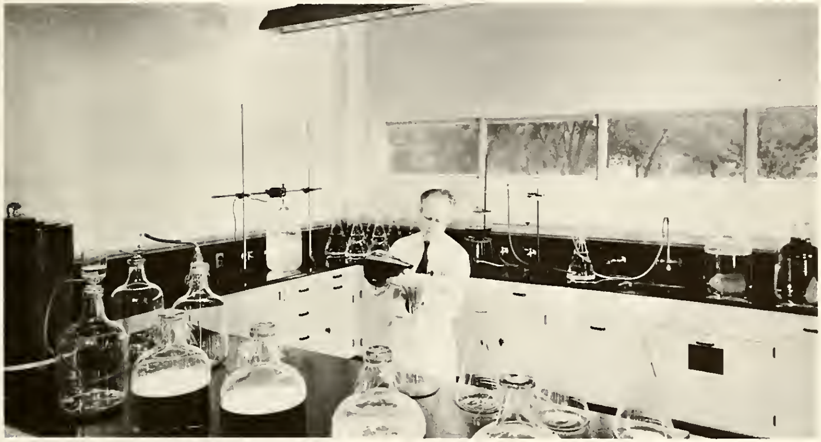
Conference and seminar room for the research staff, second floor

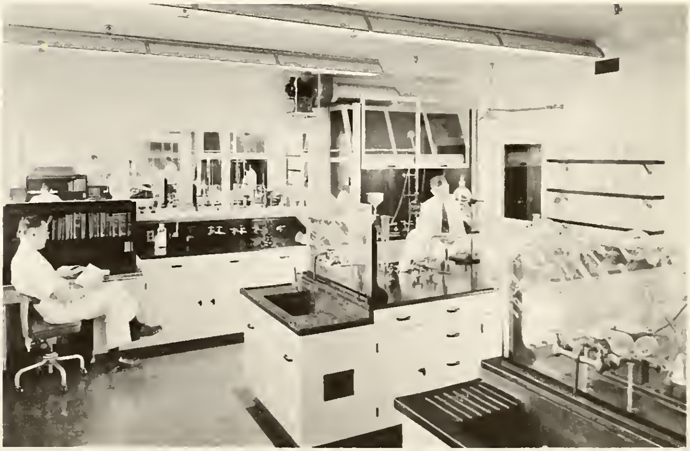
The third floor conference room serves as a lecture school

Hedrich-Blessing

Above: analytical laboratory for the control of manufacturing processes. Right: the hospital room, for emergency treatments and for regular physical examination of all employees, is located on the third or office floor, convenient to offices, stairs and restrooms

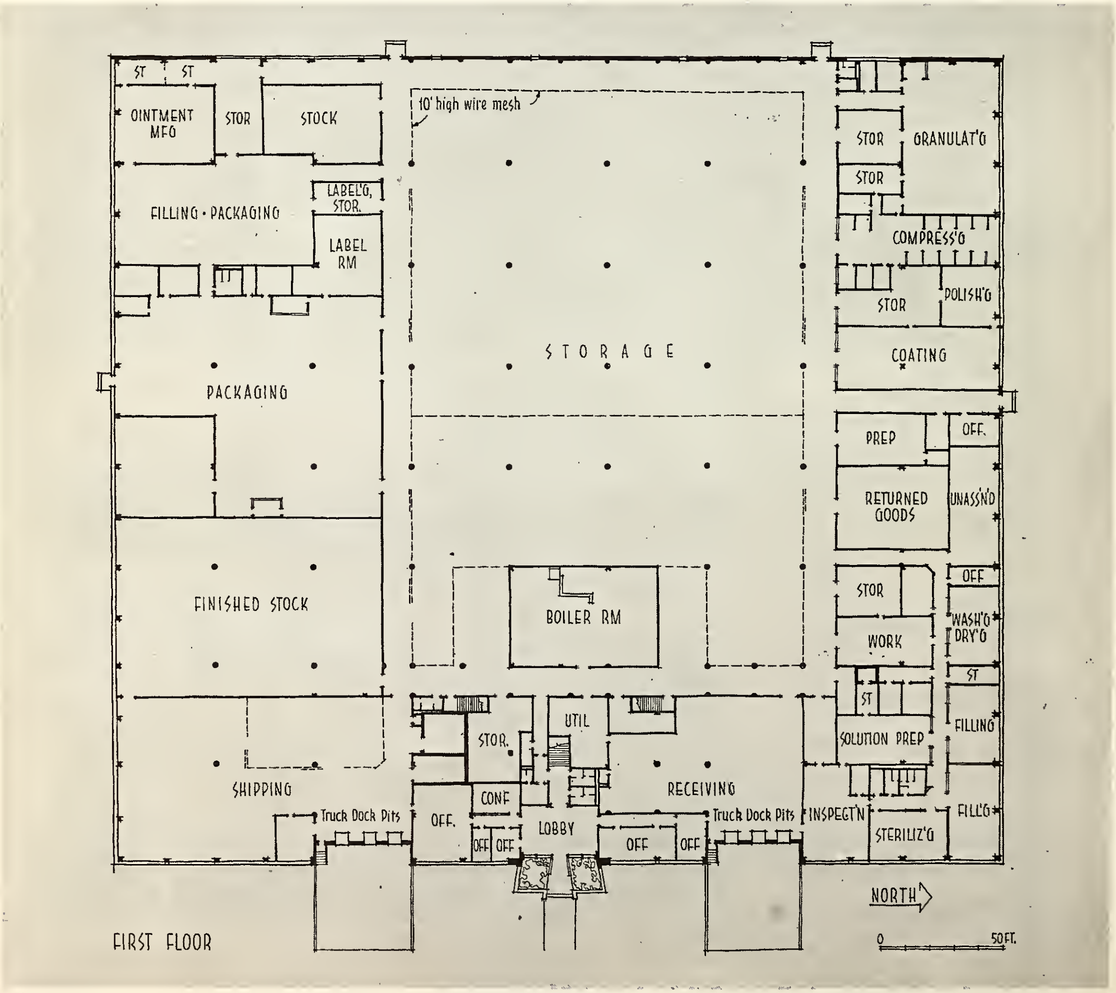






Hedrich-Blessing

Above right: preparation laboratory, for the making of rare chemicals. Above, left: one of the "ampule" rooms, for filtering solutions. Note interior view of first floor windows. Right: laboratory for organic research


ST
ST
OINTMENT MFG
STOR
STOCK
10' high wire mesh
FILLING · PACKAGING
LABEL'G, STOR.
LABEL RM
PACKAGING
FINISHED STOCK
SHIPPING
Truck Dock Pits
STORAGE
BOILER RM
STOR.
UTIL
CONF
OFF.
OFF
OFF
LOBBY
OFF
OFF
RECEIVING
Truck Dock Pits
STOR
GRANULAT'G
STOR
COMPRESS'G
STOR
POLISH'G
COATING
PREP
OFF.
RETURNED GOODS
UNASS'N'D
STOR
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WORK
WASH'G DRY'G
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SOLUTION PREP
FILLING
INSPECT'N
STERILIZ'G
FILL'G
NORTH
0
50 FT.

FIRST FLOOR

Photos: Gottscho-Schleisner

PLANT FOR PHARMACEUTICAL PRODUCTS

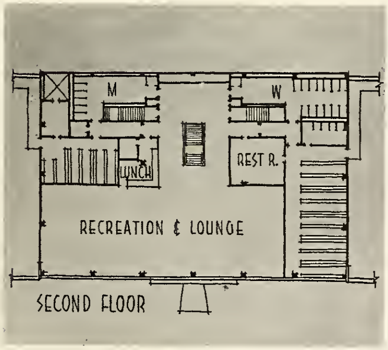
Ciba Pharmaceutical Products, Inc., Summit, N. J.

Petroff & Clarkson, Architects

Guy B. Panero, Engineers

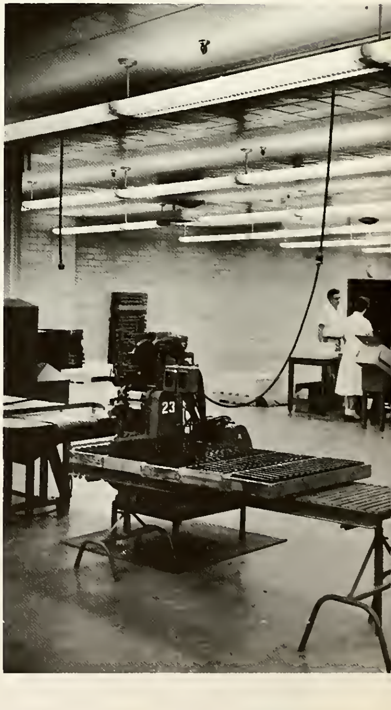
John W. Ryan Construction Company, Builders

Six essential requirements were specifically laid down for this pharmaceutical plant: 1. closely controlled temperature and humidity conditions, plus highest standards of cleanliness; 2. layout for four separate manufacturing operations; 3. design for good employee and community relations; 4. materials and finishes for hard wear and easy maintenance; 5. provision for expansion of any one area; 6. blending of the new building with the existing group. Contributing to these ends, the plan puts manufacturing operations along outside perimeter, warehousing and mechanical equipment in the center. This scheme gives workers best locations; also permits separate zone controls for air conditioning and humidity control.



Photos: Gottscho-Schleisner

In addition to the cafeteria, the second floor has recreation room with ping pong tables and so on. Second floor can be added to as required. Below, left: solution preparation room, where begins the manufacture of various ampule products. Below, right: packaging operations

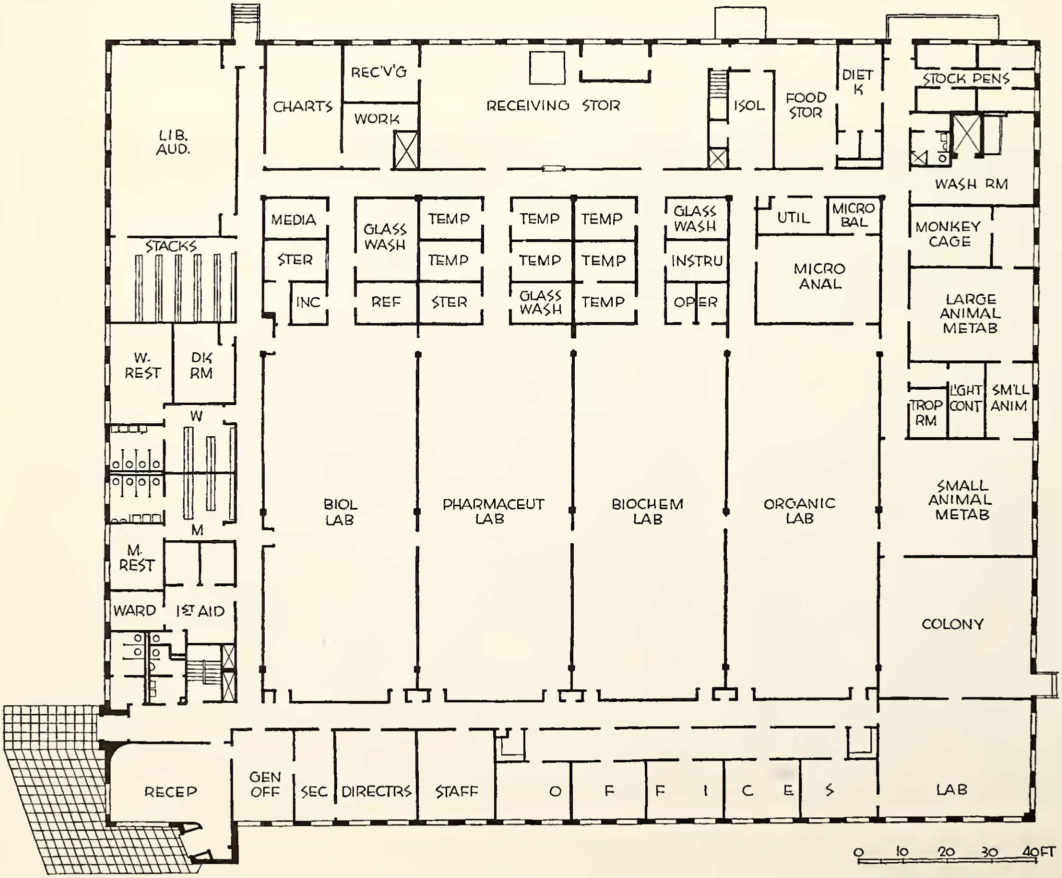


Below, left: ampule filling and sealing is done by operators in these cubicles along outside perimeter, for most pleasant working conditions. Below, right: kettles for sugar coating pills; one hose supplies warm air, the other is an exhaust. Relative humidity is 40 per cent

Below, right: large central warehouse area has ceiling height of 19 ft, and is the only part of building in which structural steel is exposed. Columns, however, are protected at base with concrete

Ben Schnall

TWIN LABORATORY AND MANUFACTURING BUILDINGS



Concept of an industrial plant: remote location; lawns and landscaping; functional facilities for both research and manufacturing

FOR ORTHO PHARMACEUTICALS

Ortho Pharmaceutical Corporation, Raritan, N. J.
Shreve, Lamb & Harmon Associates, Architects
Eadie, Freund & Campbell, Mechanical Engineers
Peter A. Strobel, Structural Engineer

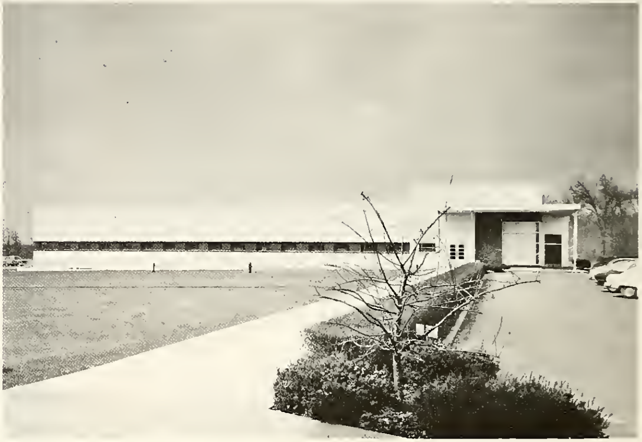
Molitor

While the two buildings shown in the photograph might be quickly described as "clean," these twins actually tell an interesting story of modern industrial thinking. One point is the remoteness of the plant from the usual industrial congestion, made possible by the small bulk of the medical products and the development of good truck transportation. As far as the worker is concerned, remoteness is an asset; easy driving and plenty of parking are preferable to any forms of transportation associated with the city. There is also the morale factor of being able to work in pleasant country surroundings, with open lawns to brighten his outlook and dignify his work. These amenities are protected by the extent of the site, which itself is made feasible by the low land cost. The plant has a substantial frontage on a railroad, permitting future installation of a spur.

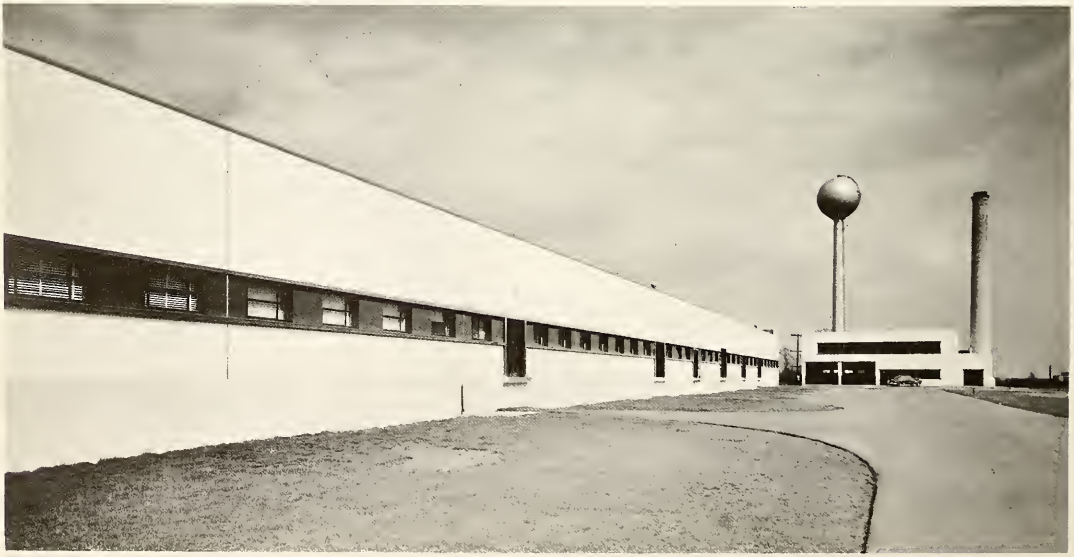
The two buildings are apparent twins, though one is a manufacturing plant and the other a laboratory, the scientific aspects of this business being comparable, space wise, to the processes of manufacturing. The buildings are connected by a tunnel for service lines, the paved top of which was intended to serve as the floor of a future connecting passage. Separate reception rooms and offices are provided in each building. The research building has a supported first floor throughout, part of the area below being used for mechanical equipment and storage, part for a crawl space 6 ft high for service lines. The manufacturing and administration building is constructed with its floor slabs on fill, except for a small basement for mechanical equipment.

Exterior walls of both buildings are of cinder concrete block with 1 in. of cement stucco on outside surfaces. At column centerlines, 35 ft on center, walls have control joints with sheet metal bellows covered on the exterior face with snap-on stainless steel strips. Window spacing and size were largely determined by the client; windows are not depended upon for illumination. All bulkheads, fans, and so forth on the roof were kept low as possible, to make them invisible from the road approach to the building, as an important consideration in this company's thinking is the very practical institutional values in architecturally "clean" appearance.

Walk between buildings is paved top of service tunnel, can be roofed over for enclosed passage if desired. Each building has reception room and row of offices along north side. Parking space is between buildings, and is screened from the road by shrubbery. Extensive lawns are considered a "must"



Long masonry walls gave some concern over movement, especially with high parapet walls. Back of parapets have an enlarged cant to equalize temperatures in attic space and behind parapets to minimize cracking at joints. Built-up roof is designed to carry a 2-in. covering of water for insulations



Molitor

Laboratories are all inside rooms, and are quite large. The owner prefers large open laboratories to small cubicles, to encourage close cooperation of research workers. Service piping runs in trunk lines in crawl space, with connections on a module of 11 ft 8 in. corresponding to table spacing

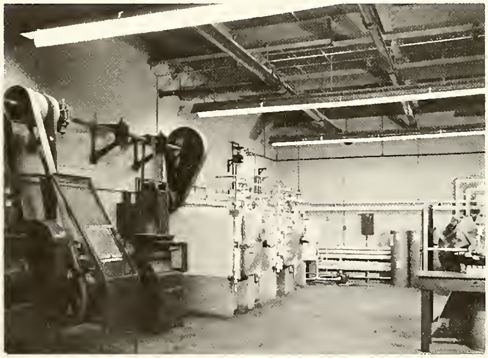
COMPLEX DRUG MANUFACTURING PROBLEMS SOLVED

WHITE LABORATORIES, INC.,
KENILWORTH, N. J.

A. M. Kinney, Inc., Architects and Engineers

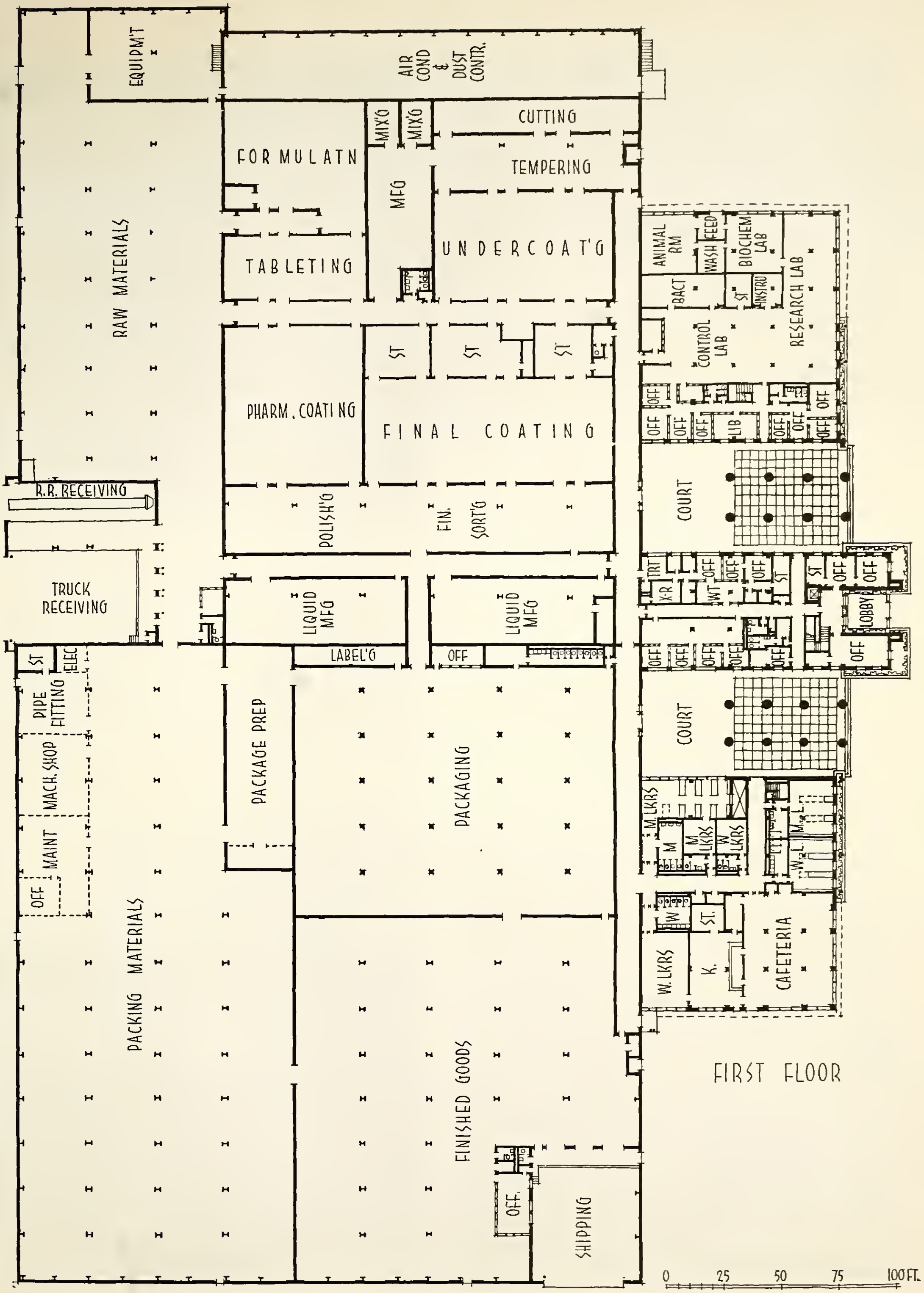
M. M. Schmidt, Landscape Consultant

Much of the production of White Laboratories, Inc. and its subsidiary, Pharmaco, Inc., consists of small medicinal tablets, including medicated chewing gum coated with flavoring and other materials. Below, tablet formulation and manufacturing areas



Since its founding 28 years ago the growth of White Laboratories has necessitated four major expansion programs. In the latest, the company moved from the city of Newark to a 125-acre rural site, where it has built a plant costing approximately $3,000,000, including site development, utilities, process piping and wiring, engineering expenses and moving costs. Land costs and expenditures for manufacturing and processing equipment, and laboratory and office fixtures brought the total well over $4,000,000.

The new plant can be expanded easily; it occupies only a small portion of the site. It consists of a two-story administrative building, 352 ft long and 90 ft deep; a one-story manufacturing building 560 ft wide and 272 ft deep; a chemical processing building 92 by 94 ft; and a 74 by 42 ft boiler house (last two not shown in plans). Construction is steel frame on concrete foundations, with walls of buff face brick, Indiana limestone and metal panels. Roofs are built-up, over either lightweight precast concrete slabs or reinforced gypsum poured over glass fiber insulating board. More interesting, however, than the large size and excellent construction of the plant is the method of solving the problems posed by the manufacturing process; this is explained on the following pages.


FIRST FLOOR

EQUIPM'T
AIR COND & DUST CONTR.
CUTTING
MIX'G
MIX'G
FORMULATN
TEMPERING
MFG
RAW MATERIALS
UNDERCOAT'G
TABLETING
ANIMAL RM
WASH
FEED
BIOCHEM LAB
BACT
ST
INSTRU
RESEARCH LAB
CONTROL LAB
ST
ST
ST
PHARM. COATING
FINAL COATING
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R.R. RECEIVING
COURT
POLISH'G
FIN. SORT'G
TRUCK RECEIVING
LIQUID MFG
LIQUID MFG
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PACKING MATERIALS
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CAFETERIA
FINISHED GOODS
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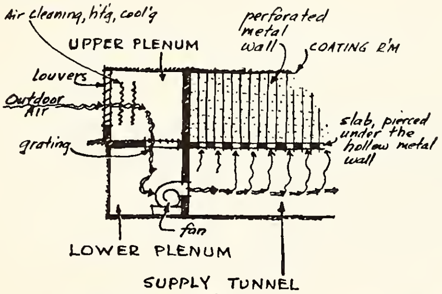
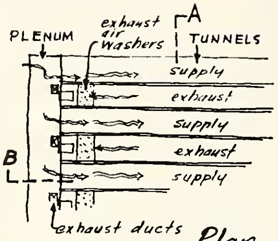
100 FT.

For the tablet coating process a unique air conditioning installation was devised Above, left, louvered wall admits outside air to a 2-level plenum. Right, upper plenum chamber; air is cleaned, brought to temperature and humidity at left, passes down through grille to lower plenum. Vertical ducts carry exhaust air to roof

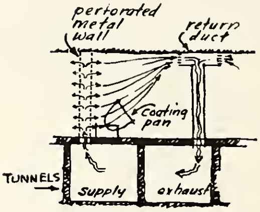
Joseph W. Molitor



Section "B"

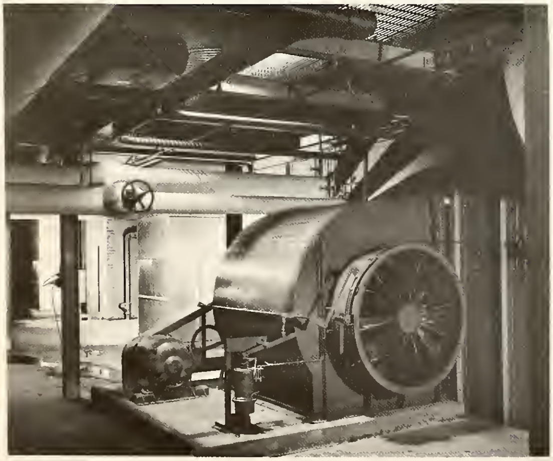


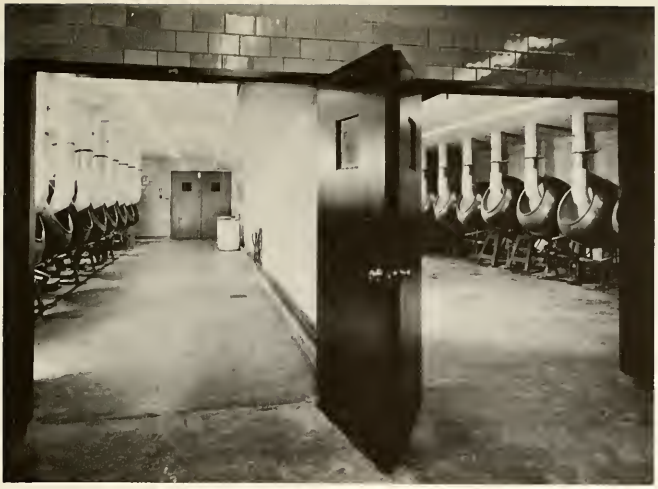
Plan



Section "A"

Below, left, lower plenum chamber, showing one of the exhaust fans which pulls used air through tunnels under floor. Right, end of exhaust tunnel showing air washer for removing dust before air is discharged

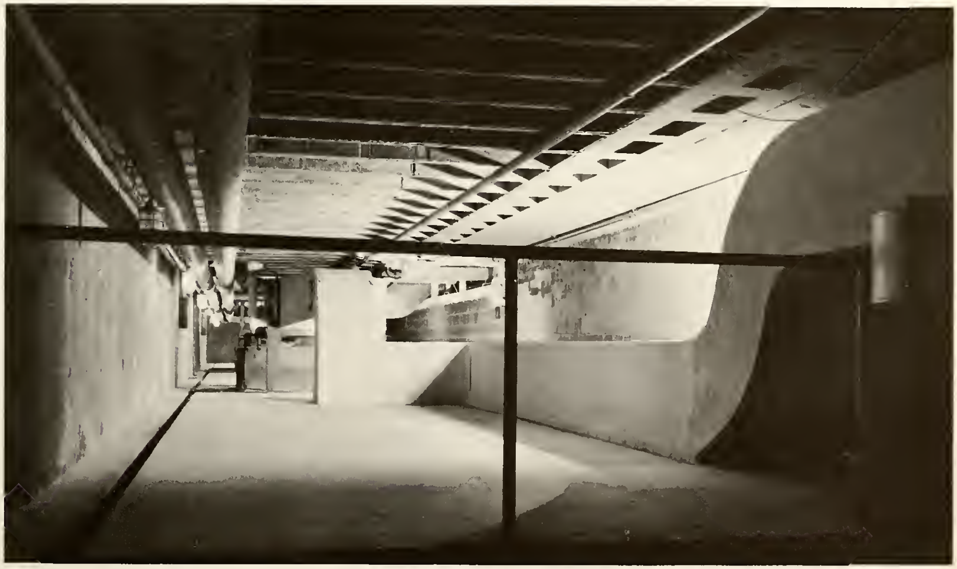


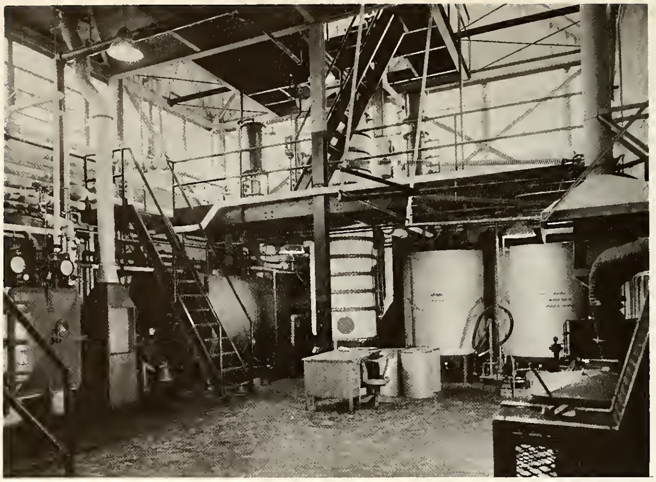


Above, left, pair of coating pan rooms. High-velocity air stream enters each pan or drum. Right, another coating pan room

White Laboratories had previously spent much time and money in nine attempts to solve problems of tablet coating. The process takes place in rotating pans into which air is blown at 50F and 65 per cent relative humidity. As the material dries, part of it is carried out of the pans as very fine dust and, in the usual case, coating room air becomes heavily loaded with the particles. This causes four problems. One concerns the possible irritant effect of dust from some coating materials on mucous membranes. Second, concentration of dust could cause dust explosions. Third, another discomfort may result from the low-temperature air blasts directed into the pans. Fourth, it is necessary, of course, in pharmaceutical manufacturing to prevent positively the contamination of one medicinal ingredient by another. Study by the architects and engineers led to development of the control technique explained in the illustrations, which was pre-tested by an experimental installation at the company's former plant. Since the volume of air circulated through the air walls is large in proportion to cooling load, there is little rise in temperature and chilling drafts are eliminated.

Below, supply air tunnels which alternate with exhaust tunnels under entire coating pan area. Air enters from lower plenum, feeds up to hollow perforated metal "air walls" through ceiling slots shown at right. Duct feeds air directly to pans at 500 cfm





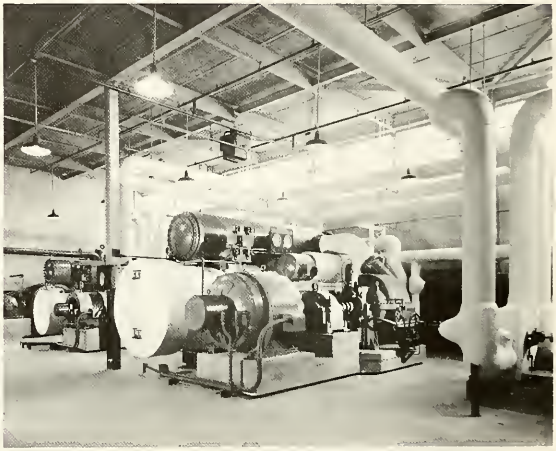
Process also involves manufacture of medicinal ingredients, laboratory procedures for testing and maintaining quality, final finishing of products, packaging and ample warehousing facilities. Left, chemical processing room showing process kettles for liquid manufacturing (see also photo far right, top of facing page). Left and right, center, two views of the air conditioned, fluorescent lighted control laboratories. Bottom left, room where gum tablets are cut and broken. Bottom right, tablet polishing and sorting room

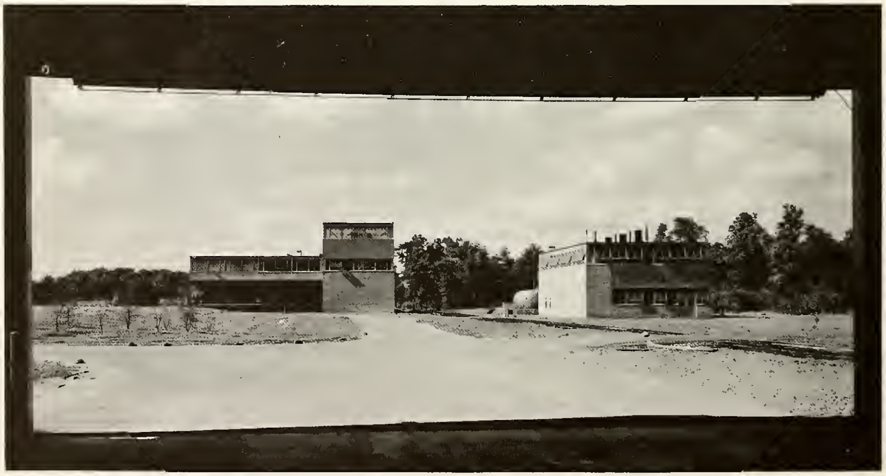
Joseph W. Molitor

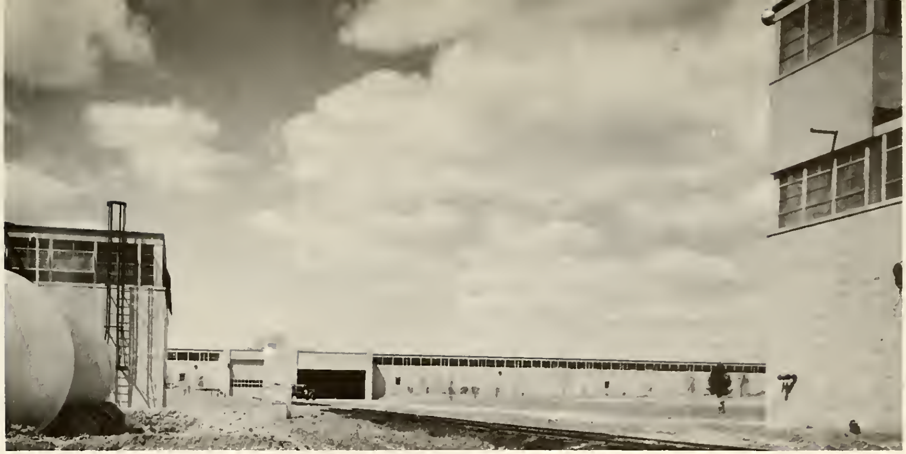
Above, packaging room; here tablets are automatically wrapped, packed in cartons and transferred to large finished products warehouse (photo below), where they are stored temporarily pending shipment

Joseph W. Molitor

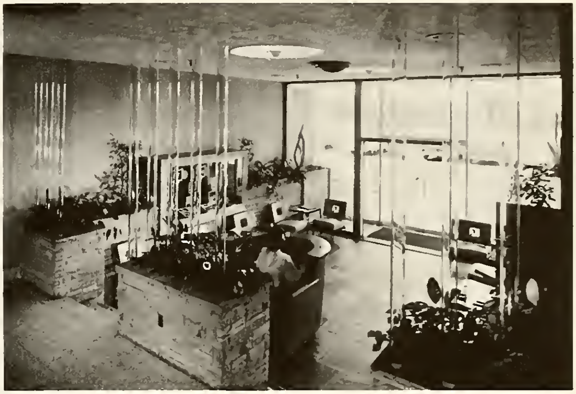
Left, animal room in laboratory wing. Below, center left, steam is supplied by three oil-fired, high-pressure boilers of a new design, each with a capacity of 24,000 lb of steam per hour at 300 lb pressure. Fuel burning efficiency exceeds 80 per cent under full automatic control. Center, right, 200-ton and 450-ton refrigeration machines; well water which has passed through air conditioner coils is reused here in condensers before being discharged. Bottom of page, chemical processing building and boiler house, seen from main plant

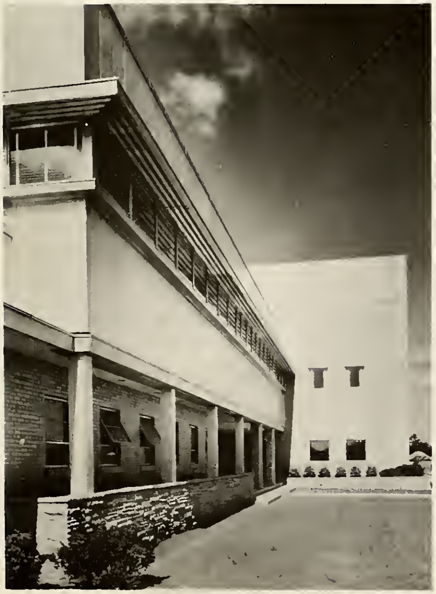


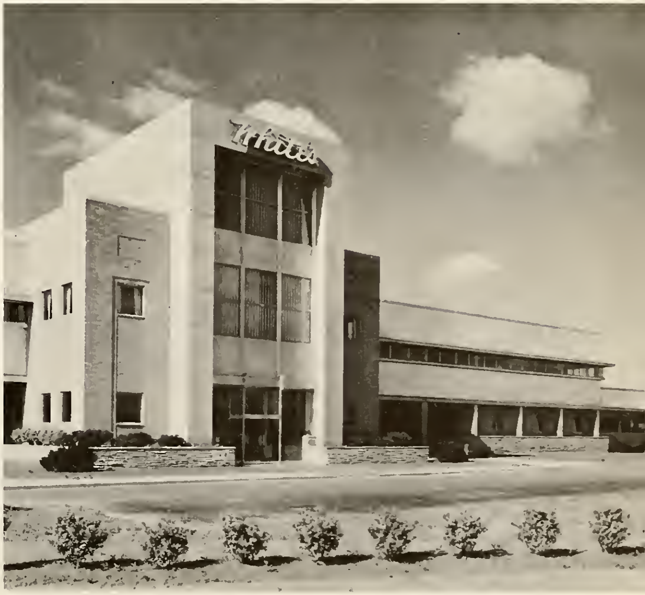




Above, boiler house at left has 3132 sq ft area; chemical processing plant at right, 7892 sq ft of space used for manufacturing medicinal ingredients of the company's products; main plant in background. Right, entrance lobby, administration building. Below, left, wing of administration building showing metal siding panels, masonry surfaces, metal sash. Below, right, central unit, administration building; third floor is an executives' conference room



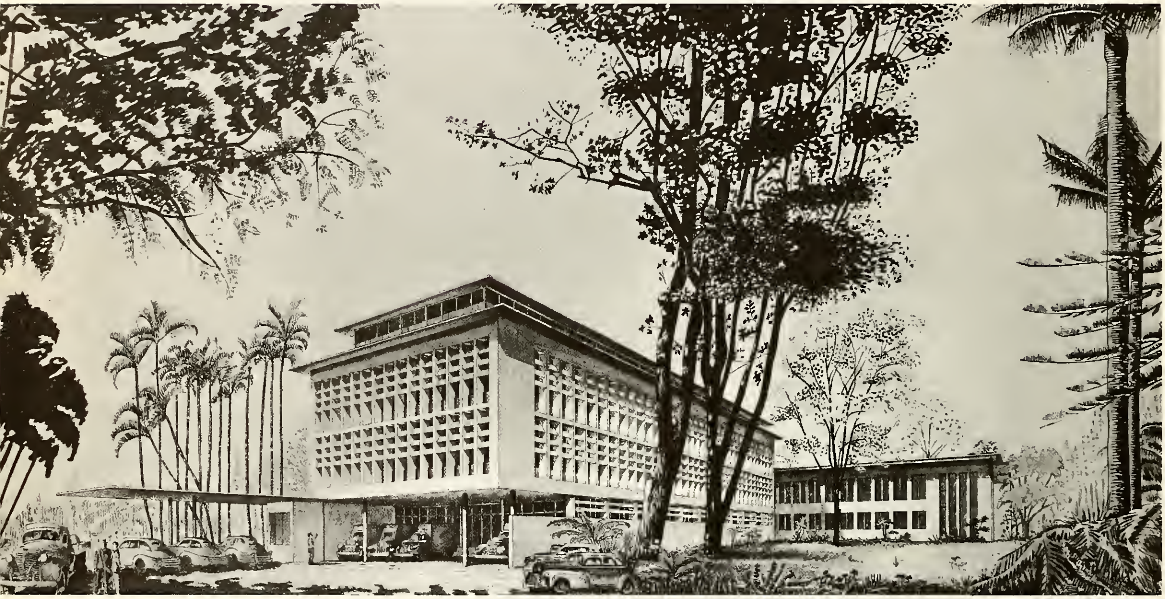




COMBINING RESEARCH AND PRODUCTION

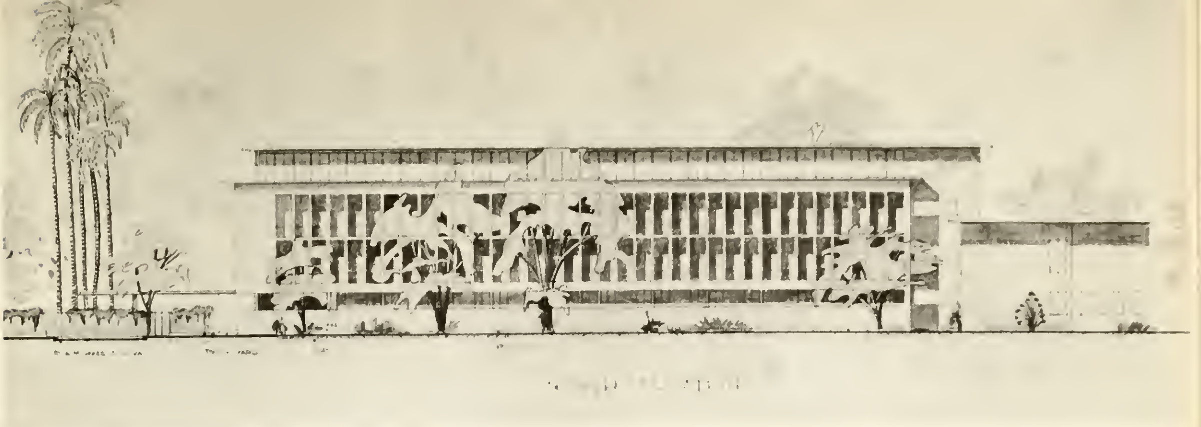
A building in Rio de Janeiro combines facilities for the development and manufacture of pharmaceutical products for Productos Roche, a subsidiary of Hoffmann-La Roche, Inc.

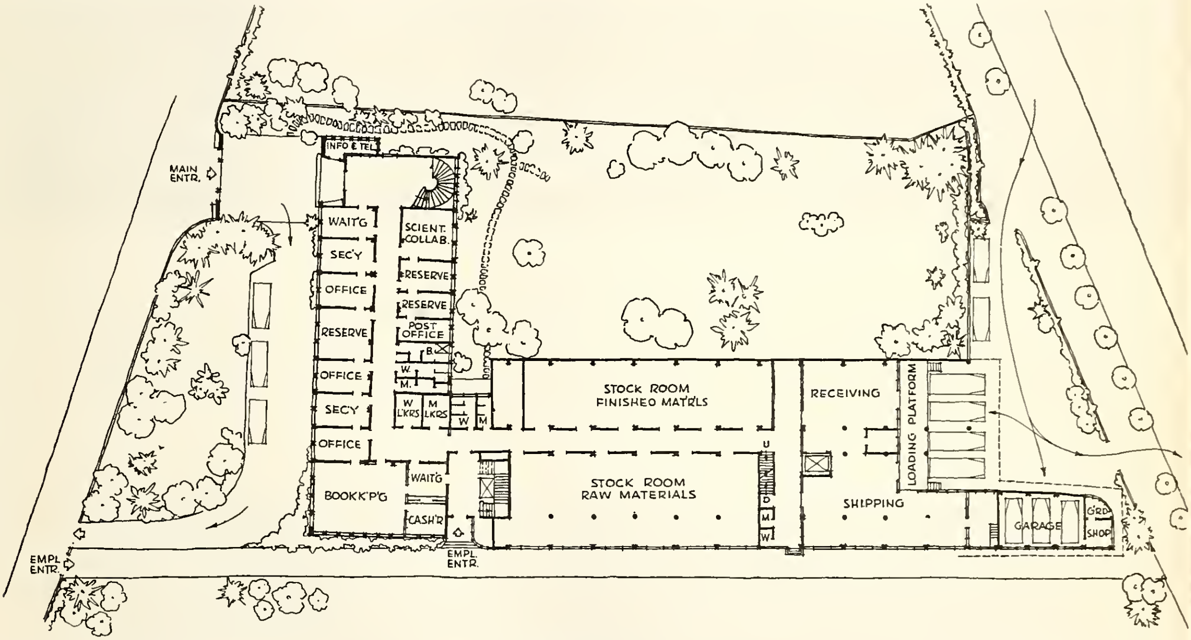
Louis Parnes, Architect



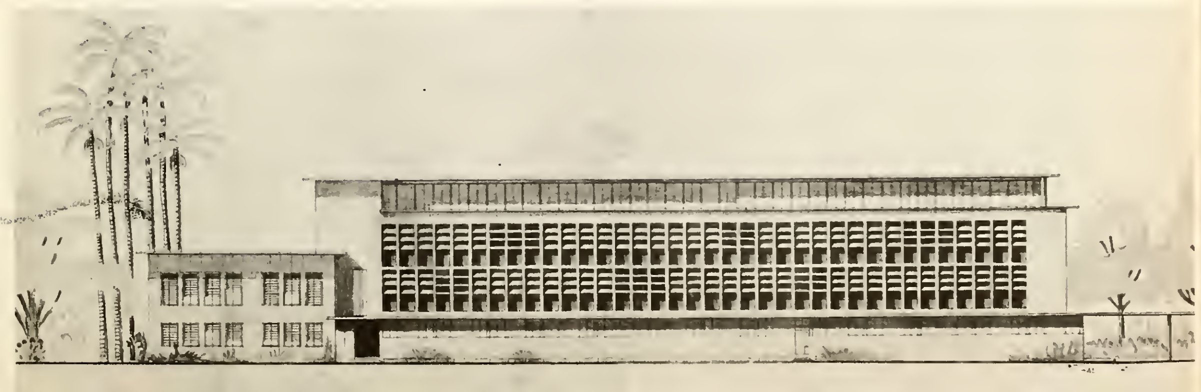
RESEARCH and production in the field of medicinal products such as vitamins, penicillin, tablets, syrups and drugs go naturally hand in hand. Logically then, they are housed in the same structure. Architect Parnes has provided therefore a plant embodying facilities for a "straight flow" process. Raw materials enter at the lower floor, flow up to the manufacturing areas and down again to delivery or storage departments. Above are the laboratories for development research, testing; and on the top floor are the employees' facilities such as locker rooms, showers, restaurant, social rooms, and roof gardens. The administrative offices are in separate wing fronting on Rua General Janabarro. Employees' entrance is, via a separate path, at the juncture of the two parts of the building. Freight traffic is entirely separate via Rua Moreas e Silva at the rear, an ideal functional division of circulation.

The plant is of reinforced concrete, the research and manufacturing portion concrete-faced (no plaster or other finish); the administration portion faced with large marble plates or veneers one inch thick. An interesting structural and functional feature of the building is the self-supporting monolithic spiral slab stair, in the administration wing.

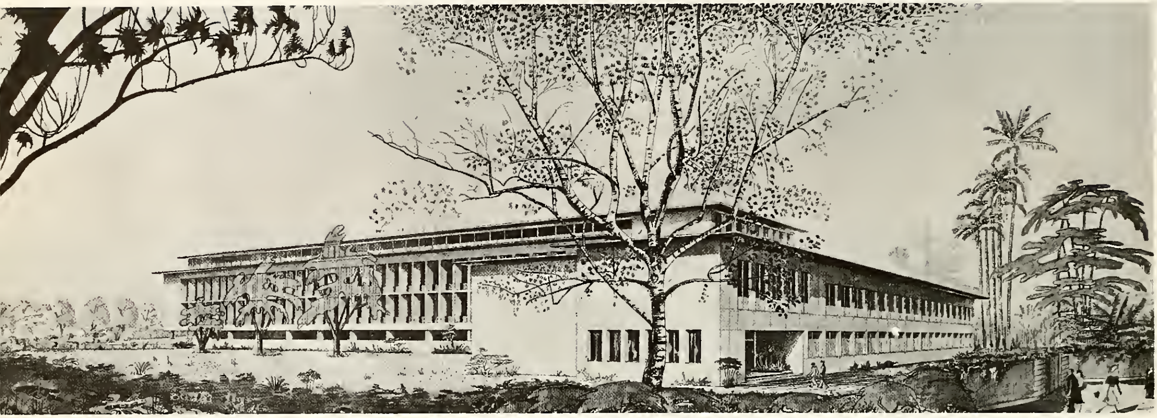




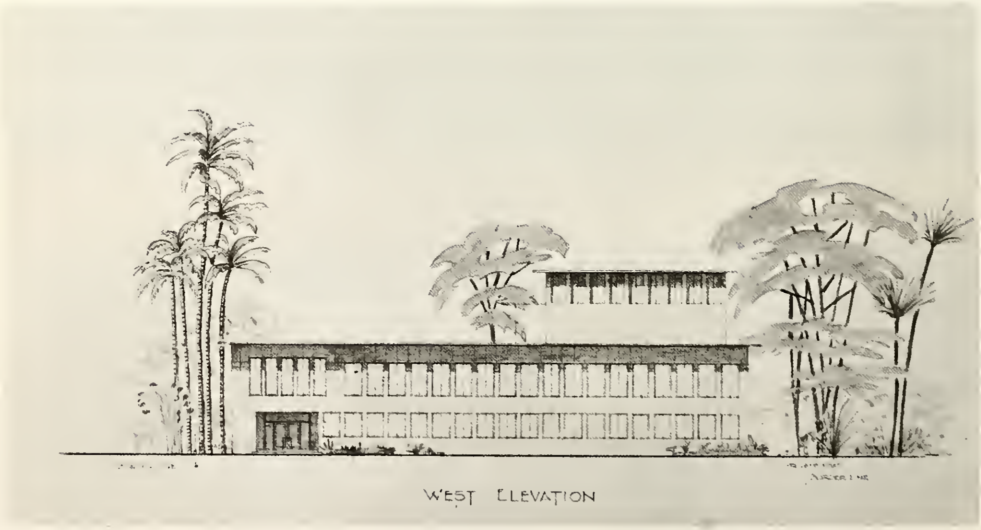
First floor plan

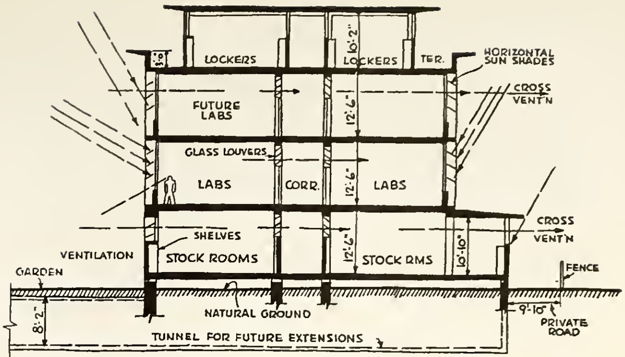


The building is unadorned and depends for its effect on the simplicity and richness of material and the natural pattern and proportioning of its functional elements. The main entrance to the building is at the northwest corner of the administration wing. The large spiral stair at the end of the entrance lobby leads to the conference room directly above the entrance and to second floor offices. The administration wing facades are faced with large slabs of marble veneer

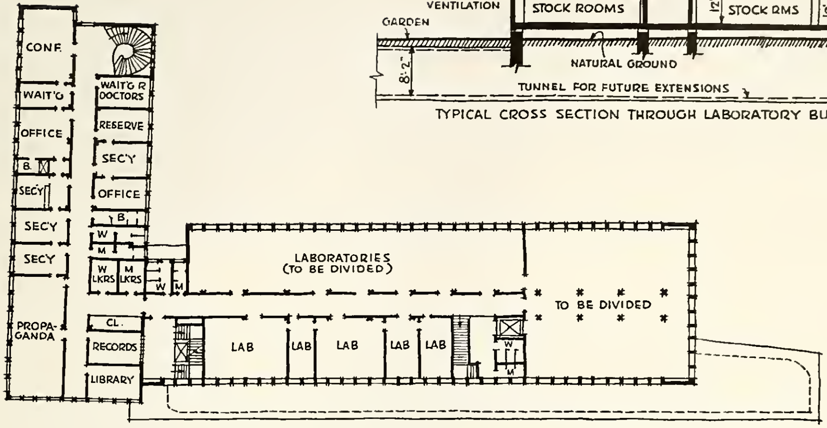


Protection from excessive sun radiation consists of thin but deep (13 feet) reinforced concrete vertical divisions equipped with horizontal movable asbestos-cement louvers. The flat roofs extend some five feet beyond the wall and provide additional protection from the sun. These roof canopies are especially reinforced to resist heat-deformation and to avoid dilation joints. To further assure comfort and proper control of air and temperature all rooms of the building are completely air conditioned.

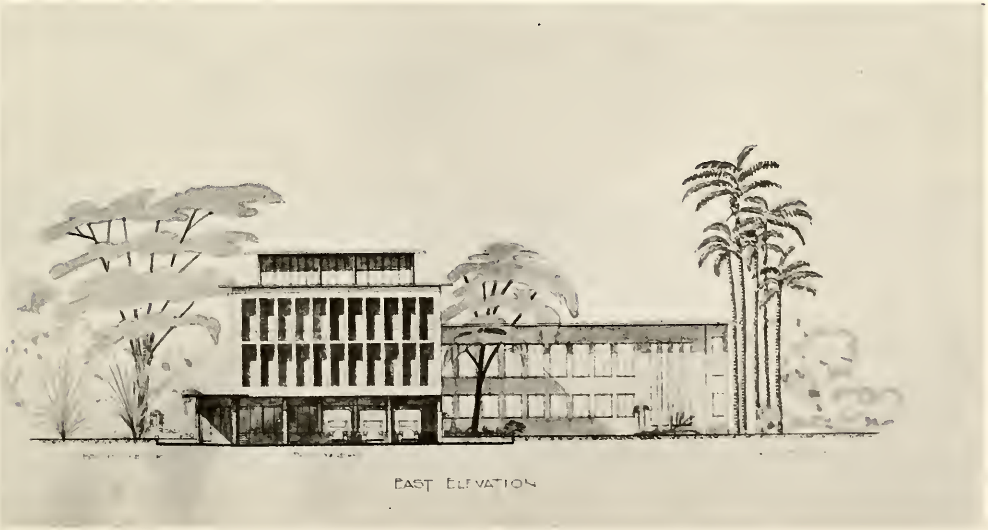


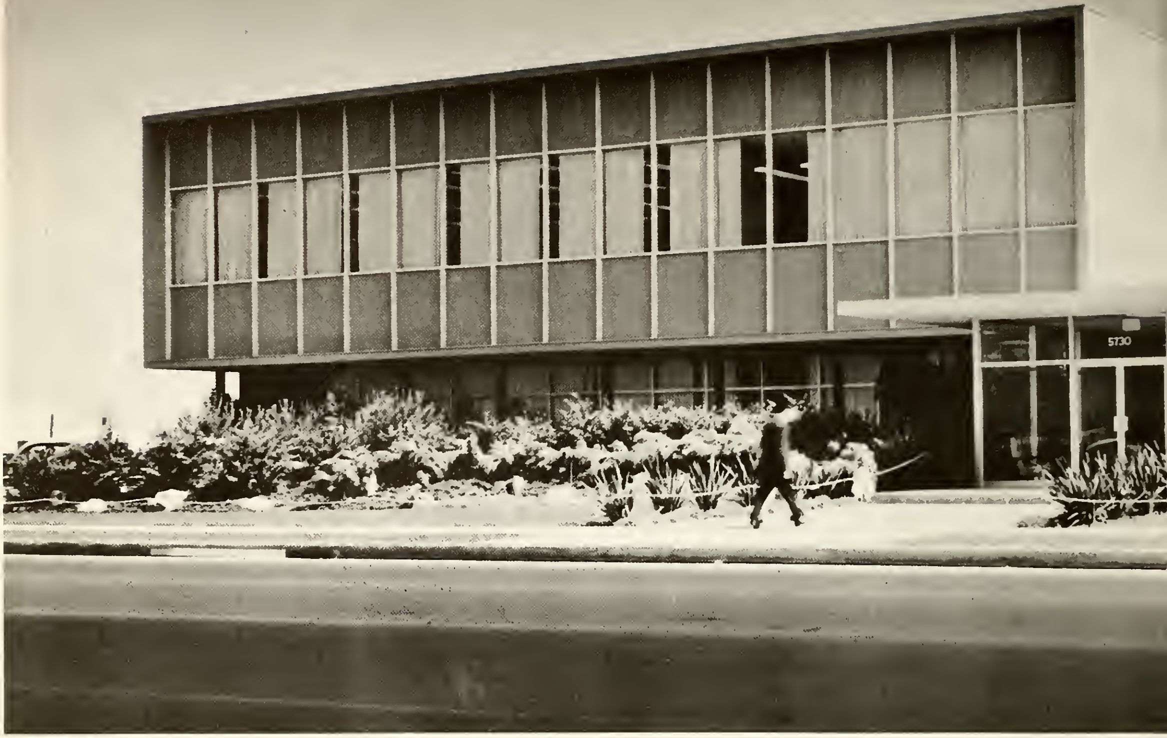


TYPICAL CROSS SECTION THROUGH LABORATORY BUILDING



Second floor plan





CONVERTIBLE DESIGN

Research Laboratories for Ramo-Wooldridge Corporation
Los Angeles, California
Eugene Kinn Choy, Architect
Eugene D. Birnbaum, Structural Engineer; Frank Lehnnan Smith, Civil Engineer; Ernest R. Dexter, Mechanical Engineer; Parr and Jones, Electrical Engineers; A. J. F. Clement, Technical Adviser; Eckbo, Royston and Williams, Landscape Architects

A RESEARCH-ORIENTED ELECTRONICS development concern, this company has grown with phenomenal speed; in fact it has grown so fast it has scared itself. This record affected the planning of its laboratory complex. The project started at one end of what is now a row of four buildings, with the conversion of an existing warehouse for office and laboratory use. Soon the company acquired adjoining acreage and three new buildings were started. These were to follow generally warehouse construction, so that they might be sold for other purposes should the fears be justified. The buildings have the height (14 ft in the clear), the construction (concrete panel tilt-up), and the more elaborate fronts of small factory buildings, though they are used only for electrical design cubicles and shop work in connection with the research.

Julius Shulman

MICHIGAN

Elmer L. Astleford

BELL TELEPHONE BUILDING

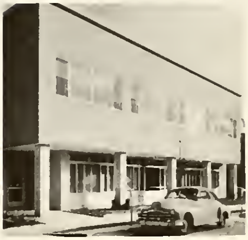
SMITH, HINCHMAN & GRYLLS, INC.
Architects and Engineers

Joseph W. Leinweber
Project Director
Minoru Yamasaki
Project Designer

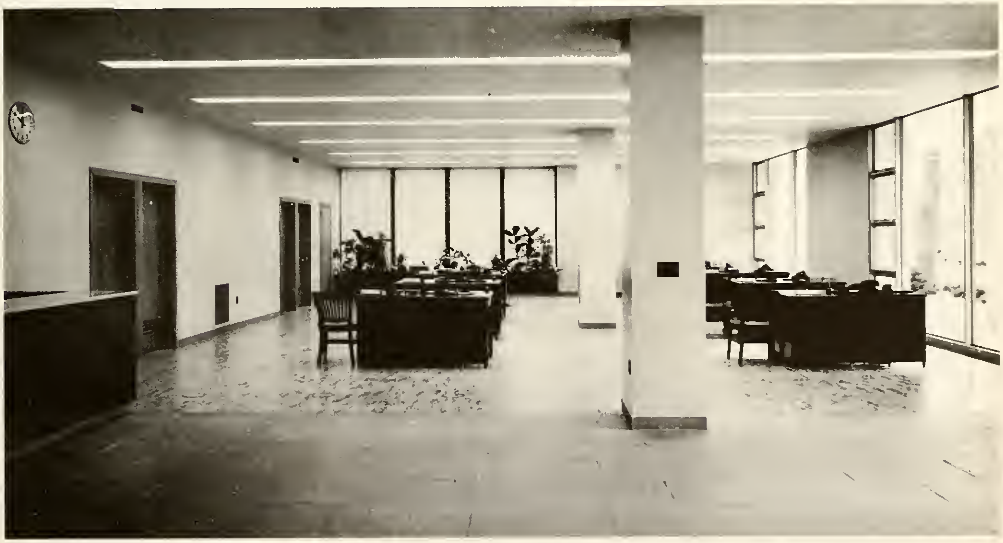
Birmingham, Mich.

WHILE it might seem that this little building could expect almost universal approbation, it was the subject of considerable controversy. Early publication of the drawings in the local paper brought out a citizens' committee which urged a return to more conventional styling. The committee sought to preserve a civic center concept in the "Tudor Gothic Revival" style of the City Hall across the street. The newspaper, and many other citizens, however, sided with the designers, and protested the thought of "horse and buggy architecture." The little story closes like many another episode in the advancement of architecture — now that the building is finished it enjoys virtually universal acclaim.

The area of the equipment room, second floor, set the size of the building on its site. First floor requirements were smaller, so it was possible to set the building back at this level to give a feeling of spaciousness next to the sidewalk and increase the planting area, which, more than anything else, fits the building into its civic surroundings.

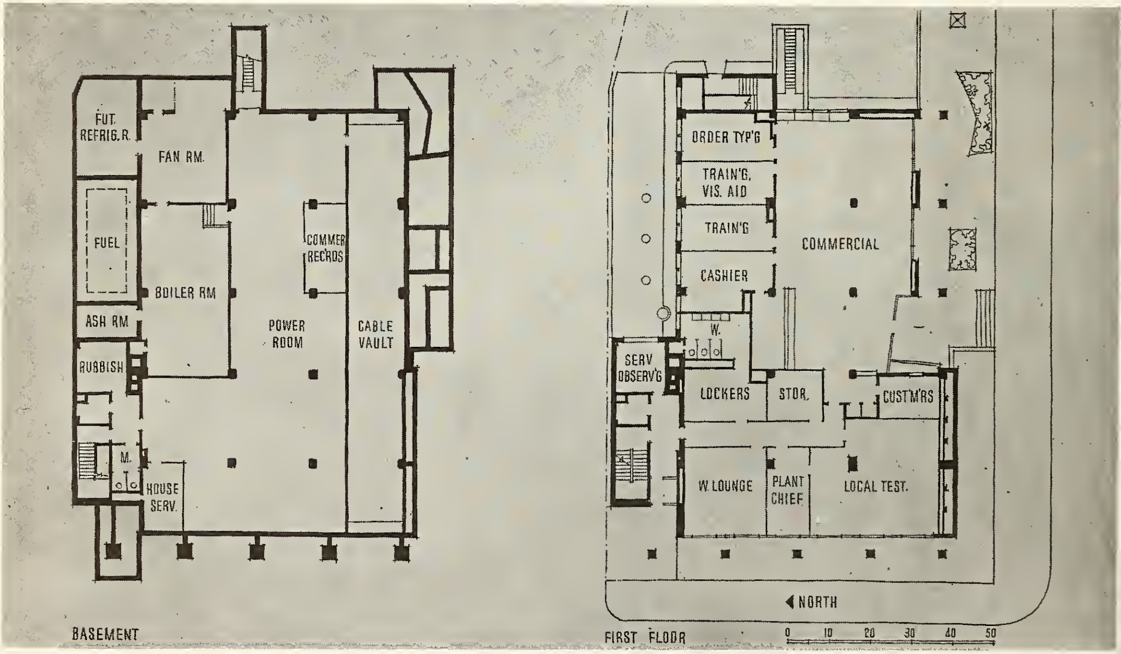


First floor areas are finished to create an architectural separation between public offices and desk areas; for the public areas, slate floor, cypress board walls, indirect lighting; for the desk area, linoleum floor, plastered walls and indirect lighting

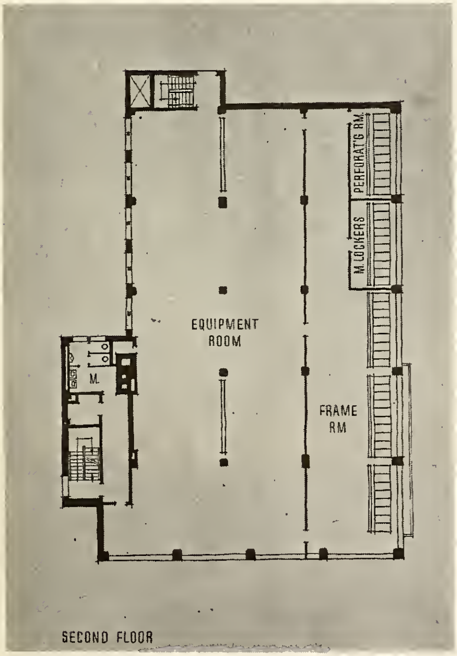


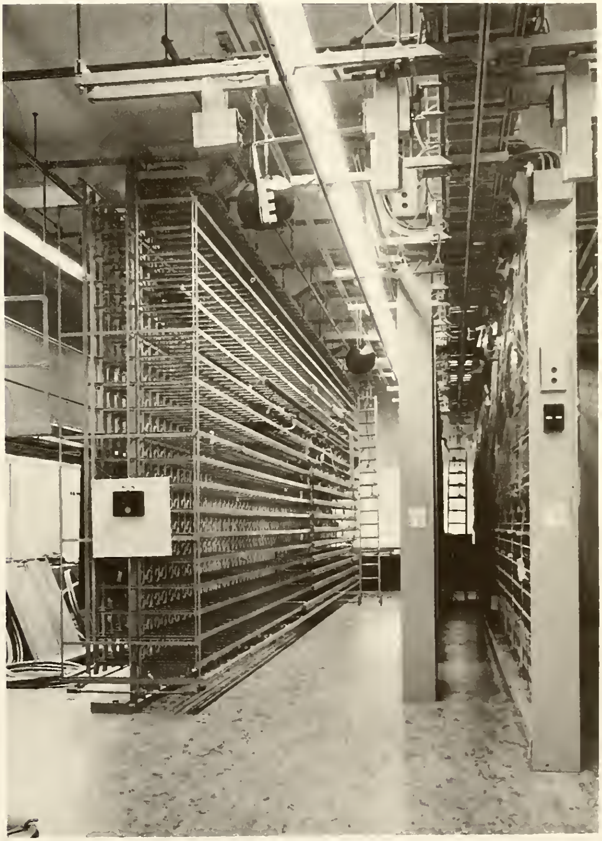
For this building with its large glass area, a heating system was chosen which would not require either direct radiation or elaborate split systems. It is a pressurized supply system with high velocity air. Small ducts are used with air velocities of 3000 fpm, with air control nozzles directing air into the room air mass at perhaps 2000 fpm. This produces a "non-directional boiling action," and quite uniform temperature diffusion. This system also keeps the building under positive air pressure, to reduce infiltration of cold air and dirt at doors and windows. It makes possible too the later installation of refrigeration, the same ducts being usable for cold air distribution. It is also said to give increased freedom of design around a public entrance, since a jet of warm air can be used instead of a vestibule.

Elmer L. Astleford



TELEPHONES

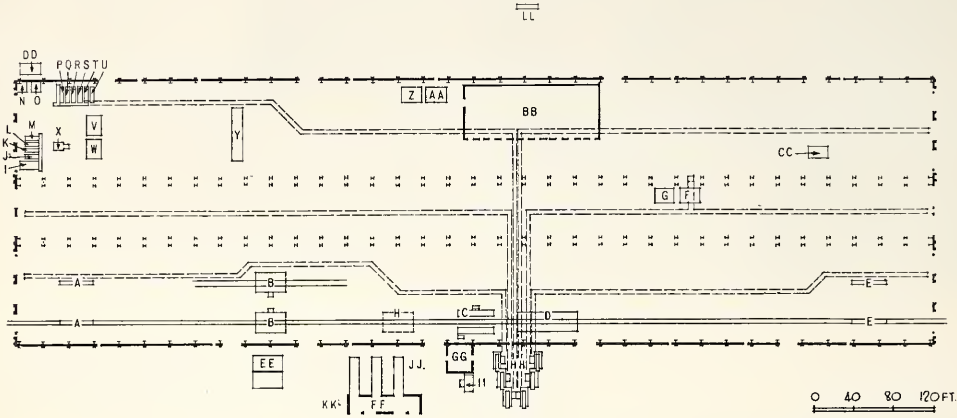

PERFORAT'G RM.
M. LOCKERS
EQUIPMENT ROOM
M.
FRAME RM
SECOND FLOOR



REPAIR SHOP COMBINES EFFICIENCY, FLEXIBILITY

Anniston Ordnance Depot Vehicle Maintenance Shop, Anniston, Alabama

Sherlock, Smith & Adams, Architects & Engineers



LEGEND

A.	Lubrication Pit
B.	Large Shot Blast
C.	Paint Booth
D.	Drying Oven
E.	Lubrication Pit
F.	Paint Baath
G.	Drying Oven
H.	Wash Rack
I.	Degreaser
J.	Acid Tank
K.	Rinse Tank
L.	Acid Tank
M.	Rinse Tank
N.	Twin Vapor Tank
O.	Wheelabrator
P.	Acid Tank
Q.	Rinse Tank
R.	Acid Tank
S.	Rinse Tank
T.	Preservative
U.	Drain Table
V.	Paint Booth
W.	Drying Oven
X.	Small Shot Blast
Y.	Van Norman Grinder
Z.	Paint Booth
AA.	Drying Oven
BB.	Dynamometer Room
CC.	Inspection Pit
DD.	Small Dust Collector
EE.	Large Dust Collector
FF.	Bailer House
GG.	Point House
HH.	General Ventilation Fons
II.	Paint Booth Fans
JJ.	Ash Reservoir
KK.	Cool Storage Silo
LL.	Pump House

The clean-cut simplicity of this immense Vehicle Maintenance Shop, planned to augment facilities at the Anniston Ordnance Depot, reflects considerable skill in organizing complex program requirements. Although specifically intended for repairing and rebuilding Army tanks, the shop also required a maximum flexibility to allow rearrangement into new types of maintenance or assembly production lines, or for conversion to other military operations.

To efficiently provide for this combination of specific and relatively undefined functions, the architects have devised a well integrated scheme, adaptable to most any type of production flow line.

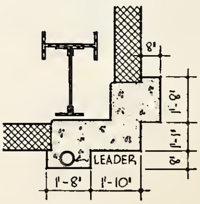
The basic structure is a lightweight steel frame resting on heavy crane supports and sheathed with corrugated asbestos and glass on the upper portion, concrete block below for protection against damage. In cross section, it is divided into three bays — 60 ft in the center, 100 ft at the sides — each of which is spanned by cranes. Bridges or crossovers at 75-ft intervals through the center bay make it possible for a crane to transport a heavy piece of equipment over the entire floor area of the 270 by 900-ft building.

To keep the shop area as open and flexible as possible, prefabricated box-car-like units were designed for use as toilets, offices and first aid stations. These can be shifted about by the cranes. The number of permanently fixed room divisions or equipment placements within the building was kept to a minimum.

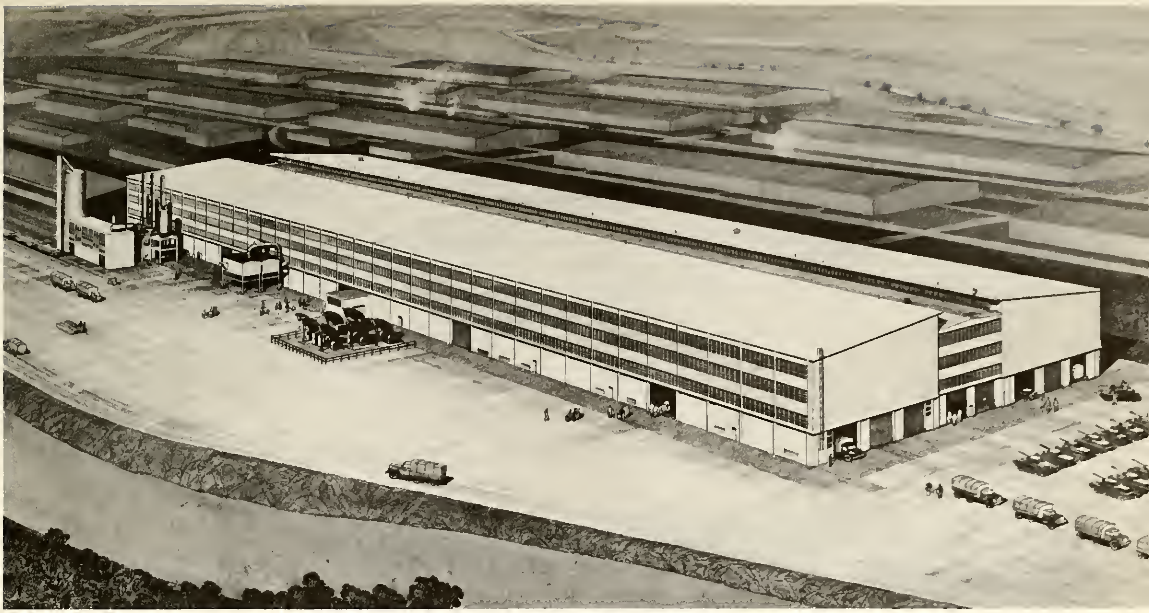
All utilities and an exhaust system to remove gas fumes are carried in underground trunk lines, with floor outlets placed in a 25-ft grid pattern. For safety, all combustible fuels, paints, etc., are stored outside the building proper.

Military personnel in charge of the project include: W. K. Wilson, Jr., Col., Corp of Engineers — District Engineer, Mobile District; Mr. G. B. Weston — Chief of Engineering Division; Mr. Arthur J. Dunn — Chief of Military Branch; Earl W. Aldrup, Col., Ordnance Corps — Commanding, Anniston Ordnance Depot.

Concrete and concrete block around the lower portion of the building form a protective shield against blows from heavy equipment (below)

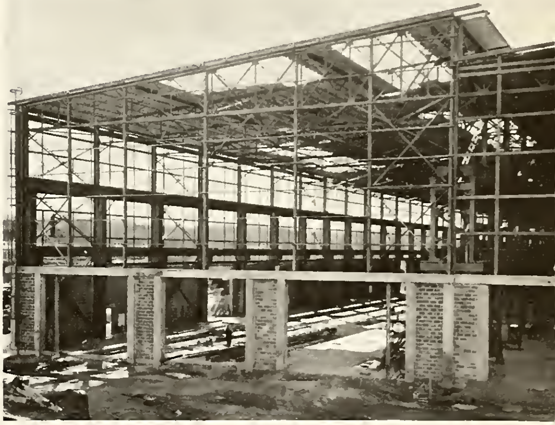


CORNER DETAIL

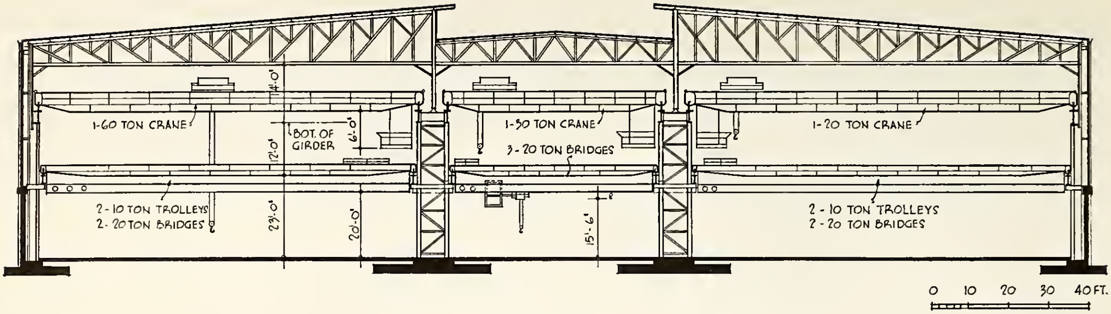


Maintenance shop has broad hard-surface surround for parking vehicles

Curtain walls sheath upper portions



Lightweight steel frame rests on crane supports

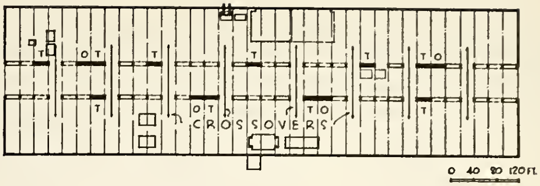


Julian Michele

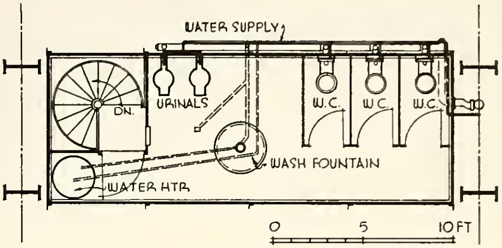
Joseph W. Molitor

The cross section of the building was determined in large part by requirements of the cranes needed to carry the heavy tanks and machinery. Heights of the lower cranes were set to permit them to lift a turret from the largest of the Army tanks and clear the framework of the tank itself. The upper cranes were spaced to give clearance with a load over the lower ones. Electrical control devices are used to prevent collision of cranes traveling on the transverse bridges or crossovers. The structural frame system carrying the cranes was designed for at least a 50 per cent overload on any of the cranes, which can also be used in multiple to handle heavier loads. The heavy supports also carry the load of the light framework for the shell of the building.

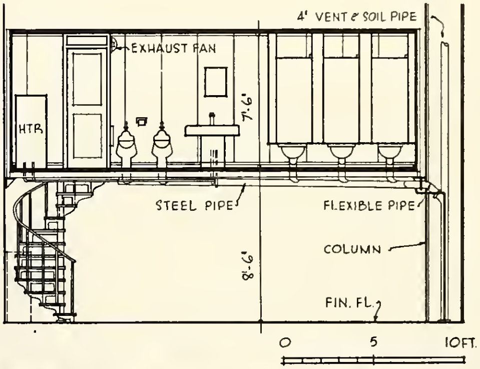
Perhaps the most novel aspect of the building is the development of the self-contained, prefabricated units for toilets, offices and first aid stations. All use a basic shell with different interior arrangements; office units, however, are provided with windows for supervision. The unit frameworks are designed to take stresses in any direction so that the cranes can pick them up and move them quickly from one location to another without damage. Brackets on the central rows of columns in the building permit the placement of the units 8 ft above floor level to clear the working space. Soil and waste lines, vent lines, water lines and electric service are provided with flexible connections at each of the locations where a unit might be set. Cast iron spiral stairs fit in steel ferrules in the concrete floor, and may be moved with the pre-fab units or separately. First aid units are placed directly on the floor for easier access.

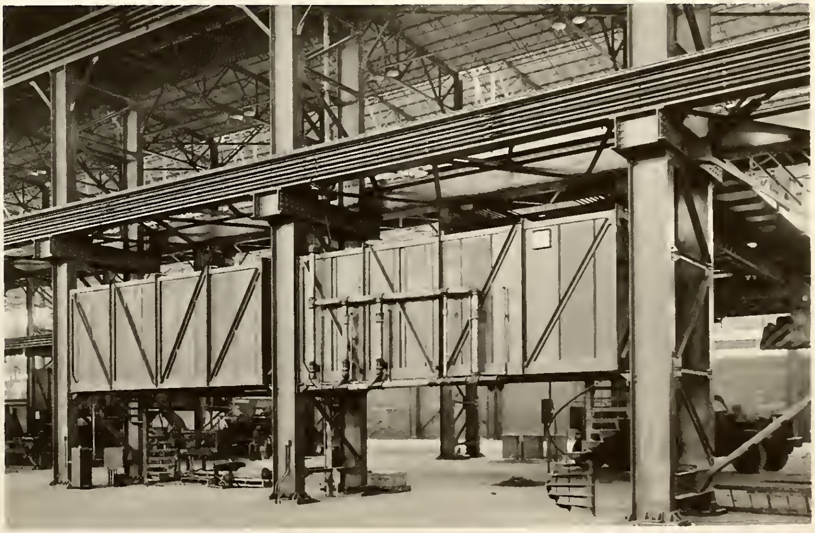


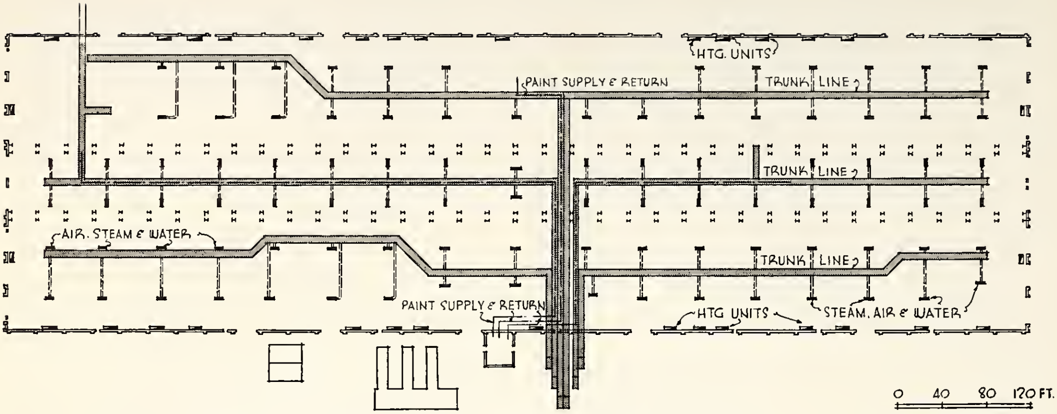
Plan above shows locations for pre-fab units, crane crossovers



Details of a pre-fab unit fitted as toilet

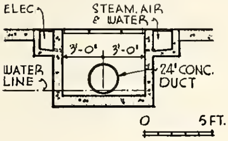






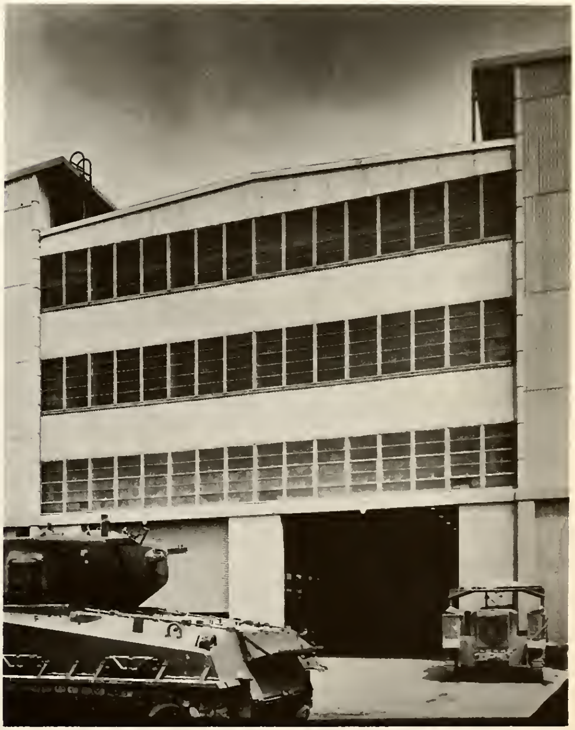
Six trunk lines under the floor of the building house utilities and air exhaust system. Branch lines connect with floor outlets (visible in photo below). Wall mounted unit heaters supply air in winter. Large blower fans outside building (across page) pull air through exhaust system

Outlet boxes for the utility system are at 25 ft intervals in the floor (detail below). Side floor chases are covered with steel plates; center portion has screened grill to prevent debris from dropping into exhaust system, water spray to reduce explosion hazard



Joseph W. Molitor

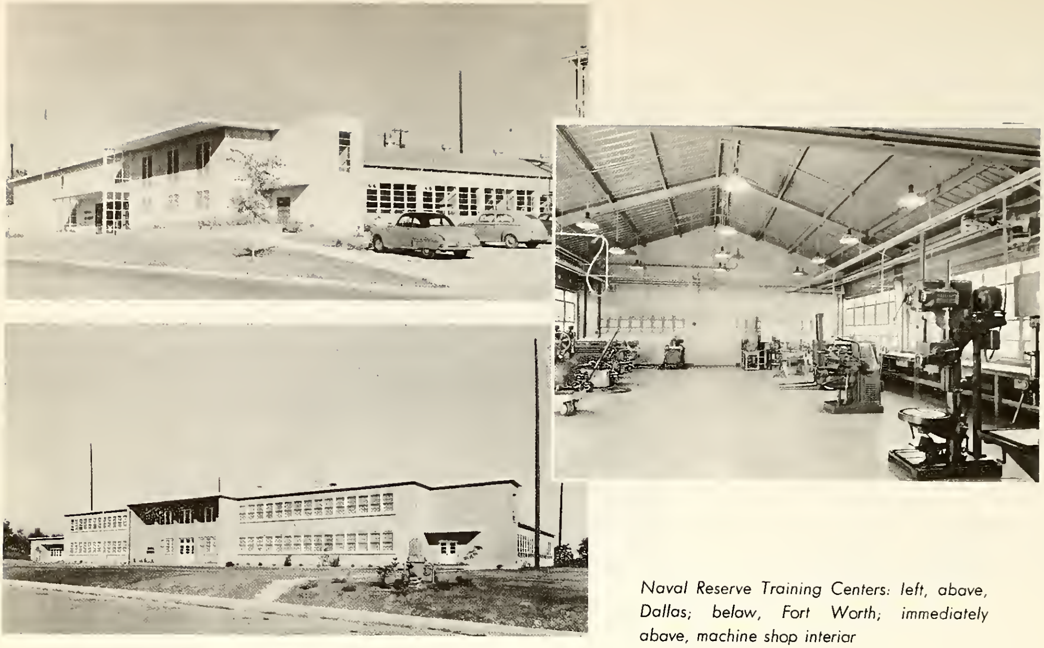
Inverted monitor in center bay gives clerestory windows to augment natural and artificial lighting



An extremely well organized system for utilities was developed to give flexibility to whatever type of operation might be used within the building. Large trunk lines carry leads and returns for cold water, compressed air, processed steam and electricity. All these are available through floor outlets every 25 ft, with the exception of steam, which is available at every other outlet. Paints and fuels are also carried through the system to certain parts of the building.

However, a major function of the underfloor trunk lines is as exhaust ducts for any obnoxious or toxic gas fumes generated within the building during the repair work. Fresh air is pulled into the building through windows and doors, then exhausted through the ducts by six blower fans located outside the building. At the floor outlets, screens and water sprays are used to minimize hazards of explosion; baffles in the ducts and automatic cut-offs control the water level. Automatic controls also regulate the air pressure within the building. In winter, the fresh air supply is provided through wall-mounted unit heaters.

Daylighting is provided by an inverted monitor down the center of the building and by three continuous strips of steel sash running the length of the structure. All sash are mechanically operated and provided with explosion-proof hardware. Artificial lighting is provided by units at the bottom of the trusses about 60 ft above floor level. Each unit contains a mercury vapor lamp and an incandescent lamp, and gives about 40 foot-candles intensity at work level.



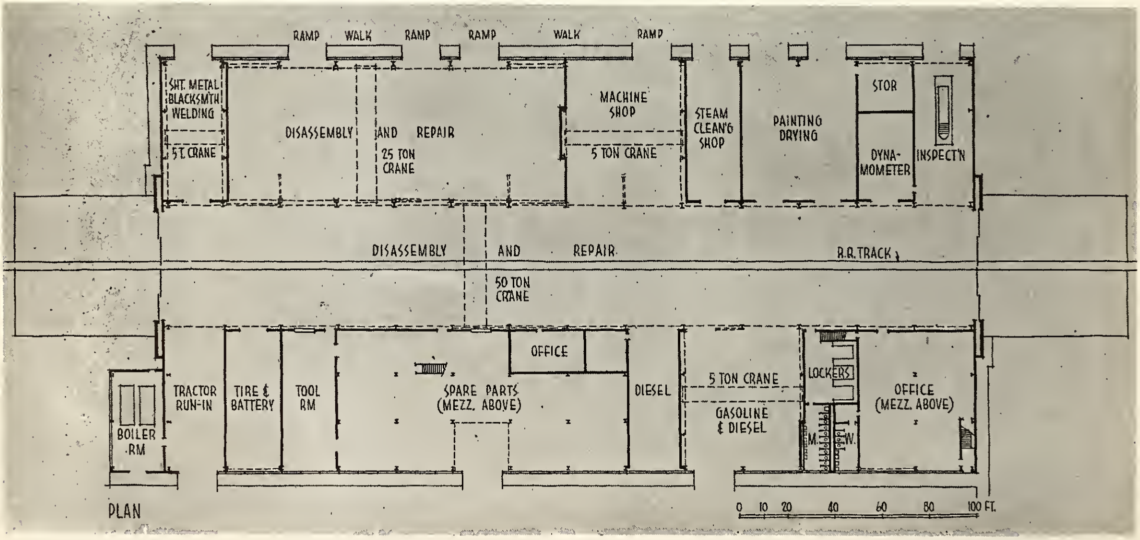
Naval Reserve Training Centers: left, above, Dallas; below, Fort Worth; immediately above, machine shop interior

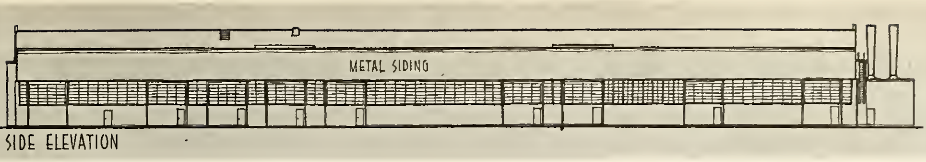
W. D. Smith Photos

ENGINEER BASE MAINTENANCE SHOP

SCHENECTADY (N. Y.) GENERAL DEPOT

Antonin Raymond and L. L. Rado, Architect-Engineers





SIDE ELEVATION

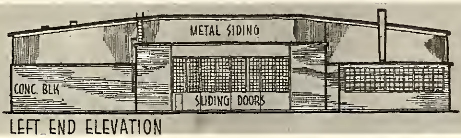
This structure is intended for the maintenance of heavy military equipment. The flow of work, following a prescribed pattern, required a number of cranes of different capacities; some to run parallel, others at right angles. This difficult structural requirement and the complicated mechanical problems necessitated complete coordination of the architectural, structural and mechanical elements and painstaking engineering. The building is a straightforward concrete block and protected metal structure—the simplest shell that could be designed to enclose the process. The walls by-pass the structure and the crane rail supports are independent of the building structure. Roof over center bay is flat to simplify the structural steel connections—another example typical of the design approach.

George E. Hartman, Col., Q.M.C., Commanding Officer

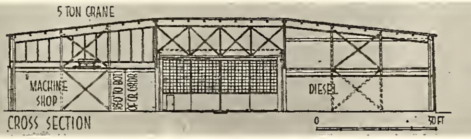
Alfred H. Davidson, Jr., Col., C.E., District Engineer

Charles K. Panish, Chief, Engineering Division

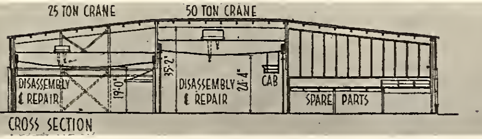
Stanley S. Haendel, Chief, Design Division



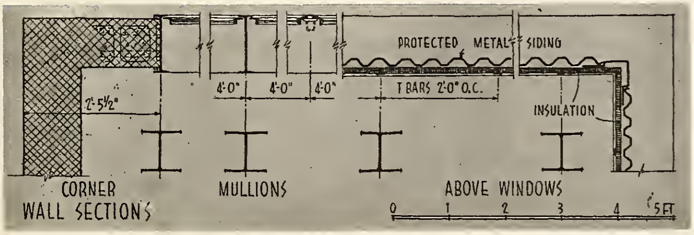
LEFT END ELEVATION



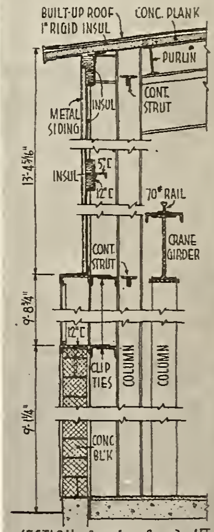
CROSS SECTION



CROSS SECTION



WALL SECTIONS



SECTION

MAINTENANCE SHOP FOR DIESEL LOCOMOTIVES

For Chicago and North Western System at Chicago

De Leuw, Cather & Co., Engineers
E. C. Vandenburgh, Chief Engineer for the Railroad
A. N. Rebori, Consulting Architect

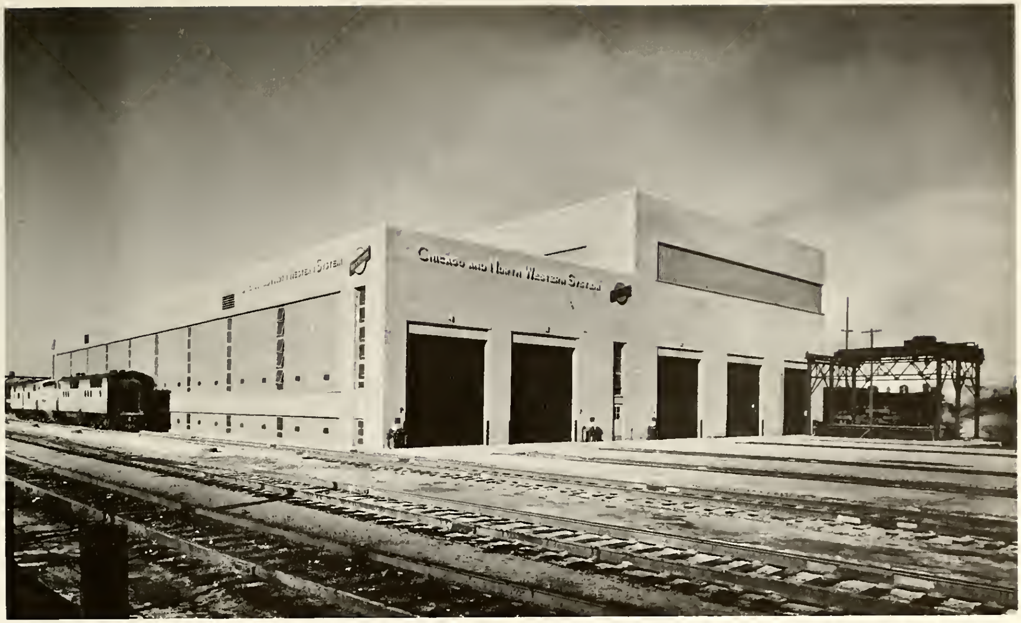
WHEN DIESEL LOCOMOTIVES first appeared, in the late Twenties, they introduced maintenance problems which finally led to the development of a new type of building. Maintenance was first handled in converted stalls in roundhouses, but these proved poor arrangements at best, and became totally inadequate as diesels grew in length. Some railroads even tried to service them outdoors, on through tracks, but outdoors is a poor place for parts cleaning, motor overhaul, battery charging and so on. About ten years ago the railroads realized that the trouble was basic, too much "steam thinking." So they developed a building functionally designed for the new type of locomotives, complete with the proper access platforms and pits, cranes, shop facilities.

This project, costing $1,800,000 equipped, also bids for attention as the first heavy construction in Chicago devised on the modular unit principle. Approximately 1,000,000 brick of the new modular size which lays up in exact 4-in. squares were used in this project. These dimensions allow coordination of such factory fabricated building components as glass block, steel sash and doors, and eliminate needless waste and expensive field cutting and trimming.

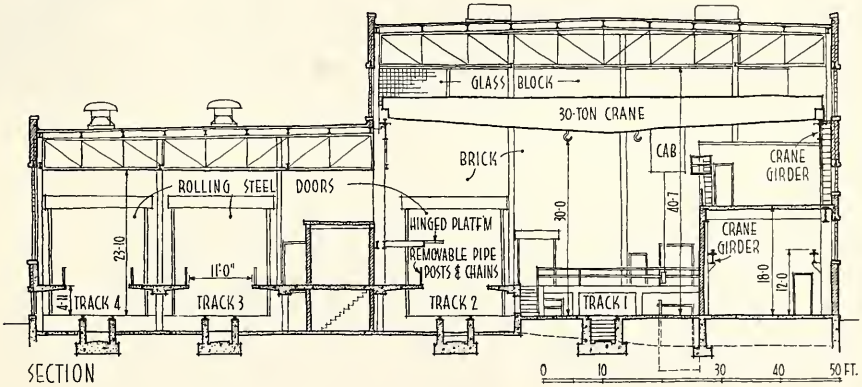
Basic construction consists of a cast concrete pile and reinforced concrete foundation, structural steel frame, precast concrete roof deck and curtain walls made up of 14,000 sq ft of glass block and 3500 sq ft of steel sash. Glass block were chosen for good distribution of daylight without glare, insulation, and permanency plus low-cost maintenance; railroads like to erect buildings, then forget them.

Heating and ventilating involved the special problems of large volumes of air changes, both because of the size of doors and the ventilation requirements. So the heating combines unit heaters with radiant floor panels, the latter for men working around the engines, the former for rapid recovery of air temperatures. Manually operated exhaust fans, set above the service tracks, take care of extra ventilation needs when an engine is operating.

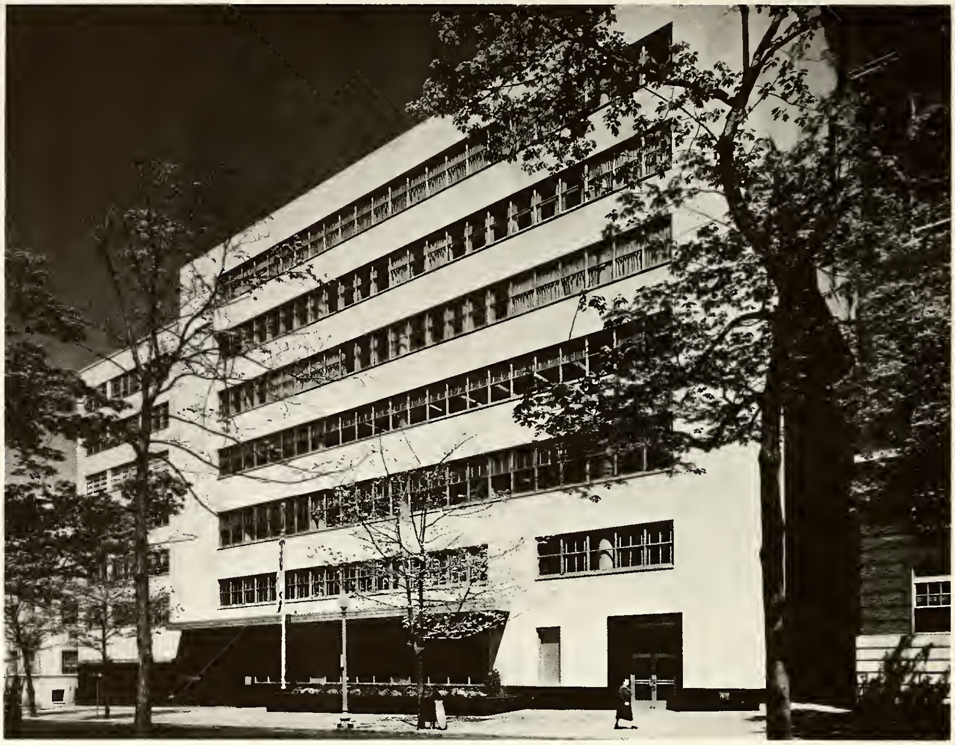
Another feature is a radiant snow melting system in the outside ramps. Heating coils of wrought iron pipes are laid in gravel under the concrete slabs.



Hedrich-Blessing Studio



Shop contains 1,928,000 cu ft; consists of two major wings. One is for service and repairs, the other for storage and auxiliary shop work. Service wing (section above) has high-bay portion for heavy repair, low-bay for fast servicing. High bay has one through track and two stub tracks, spanned by a 30-ton crane. Low bay has two through service tracks, both provided with track sections (not shown) which are lifted hydraulically to platform level for convenience of workers and for speed in handling routine servicing



COMPLETE PLANT FOR A NEWSPAPER

Building for The Washington Post, Washington, D. C.

Albert Kahn Associated Architects and Engineers, Inc.

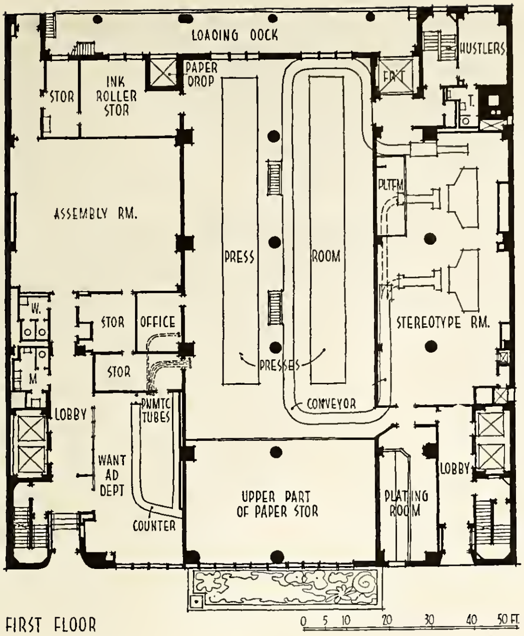
THIS NEW BUILDING reversed the problems usually met in industrial buildings of today, in that a complete newspaper plant had to be shoehorned into a downtown site, the various facilities being stacked up instead of strung out in assembly-line fashion. As a matter of fact, the program changed several times, once after contracts were let and footings poured. At any rate, with the Washington height limit, the principal problem was fitting everything into an inside plot which was none too large.

The huge presses occupy a two-story main floor, open to paper storage area in the basement. The high front windows serve the double purpose of making an interesting display of the busy presses, and permitting changes in press machinery, since the windows are made easily removable. Rear windows are similarly designed, though the need for a loading dock complicates the rear section. Foundations for the presses and their heavy motors are isolated from main building footings, to prevent the transference of press vibrations to the building frame.

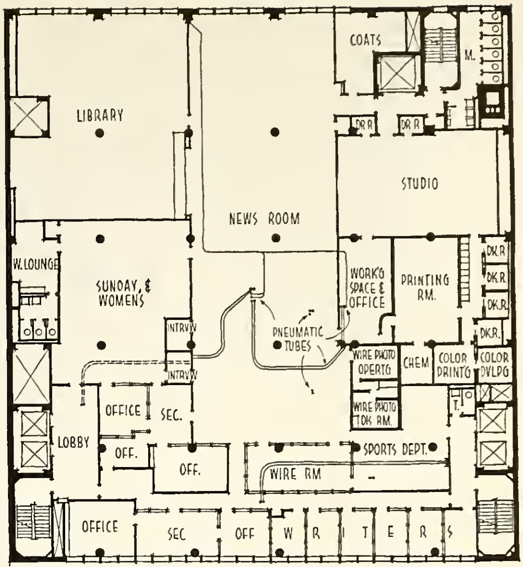
Some space was sliced out of the first floor for a want-ad office for the public, an assembly room to one side of the press room, and an employees' entrance.

Second floor, beside the press room, has space for employees' facilities — lockers and snack bar — visitors' balcony overlooking presses, and some unassigned office space for expansion. Third floor is largely occupied by the mail room; the fourth by composing and engraving departments; fifth, sixth and seventh by the offices.

Each floor is completely air conditioned, with separate zone controls for each story. A complicated system of filters is arranged to take ink vapors out of the air exhausted from the press room, some filters at the duct openings, more at the exhaust, to prevent discoloration of this and surrounding buildings.



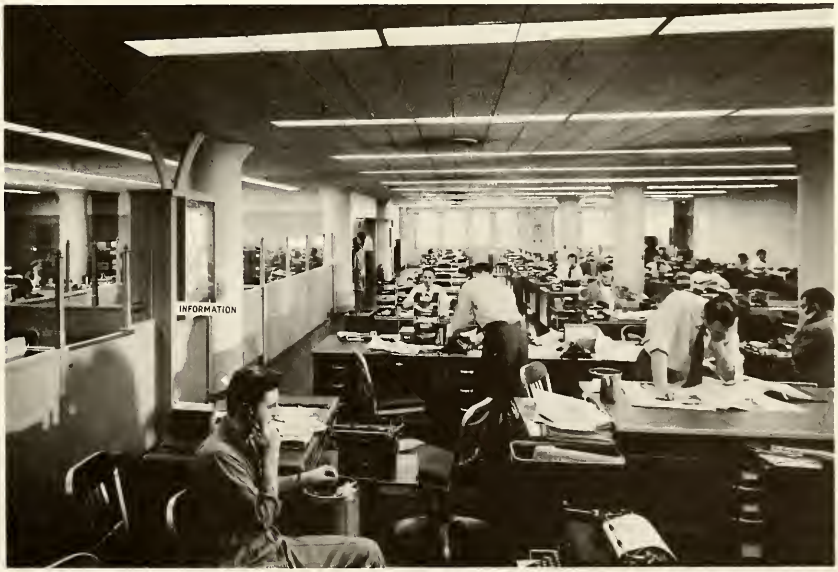
FIRST FLOOR



FIFTH FLOOR

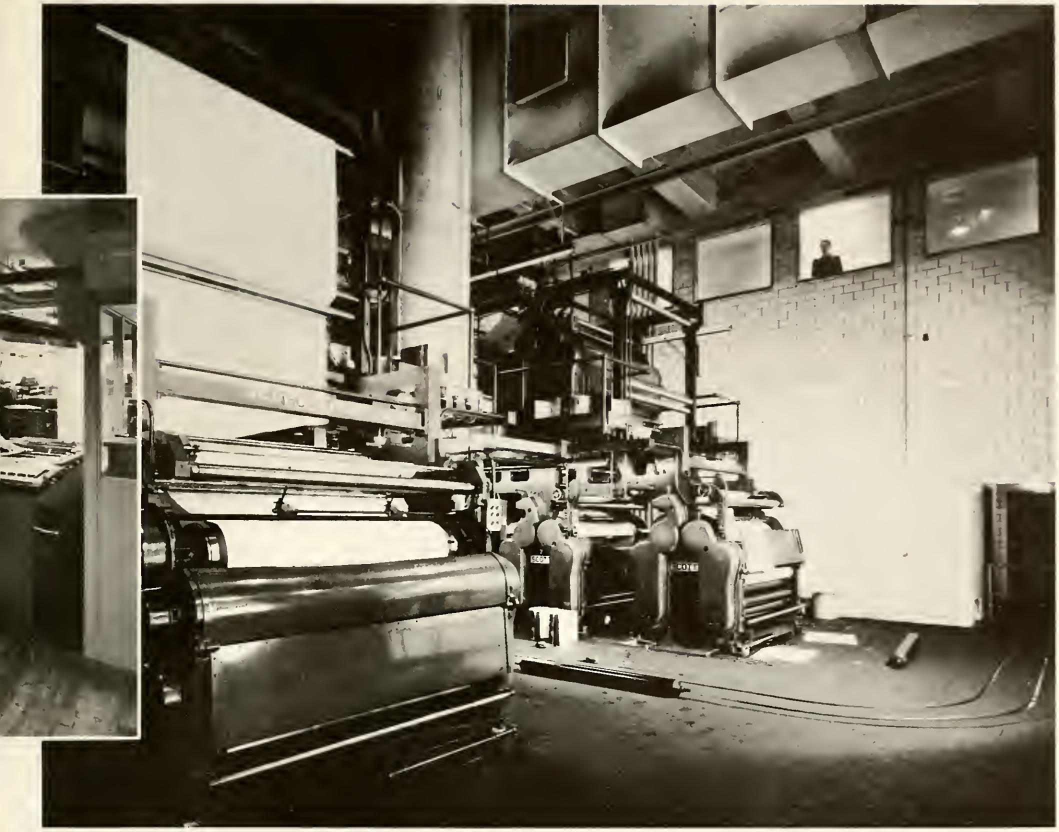
Building represents 100 per cent coverage of an inside lot measuring 120 by 130 ft. Lower floors are devoted to presses and other mechanical operations; upper floors to office space View below shows main news room on fifth floor. Entire building is air conditioned

Robert C. Lautman

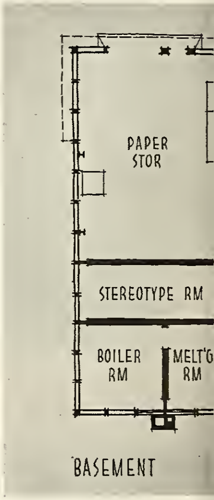


Robert C. Lautman

Upper left: want ad counter beside first floor entrance. Left center: assembly room on first floor. Above: composing room on fourth floor. Lower left: office of the chairman of the board, Mary Barnes, decorator. Opposite page, above: large presses are displayed on first floor; the public also has a viewing gallery at second-floor level. Opposite page, left: first floor opens to basement for convenient handling of 2000-lb rolls of paper. Opposite page, right: a view of the mail room occupying most of third floor



Joseph Molitor Photos



CALEDONIAN RECORD PUBLISHING CO., INC.

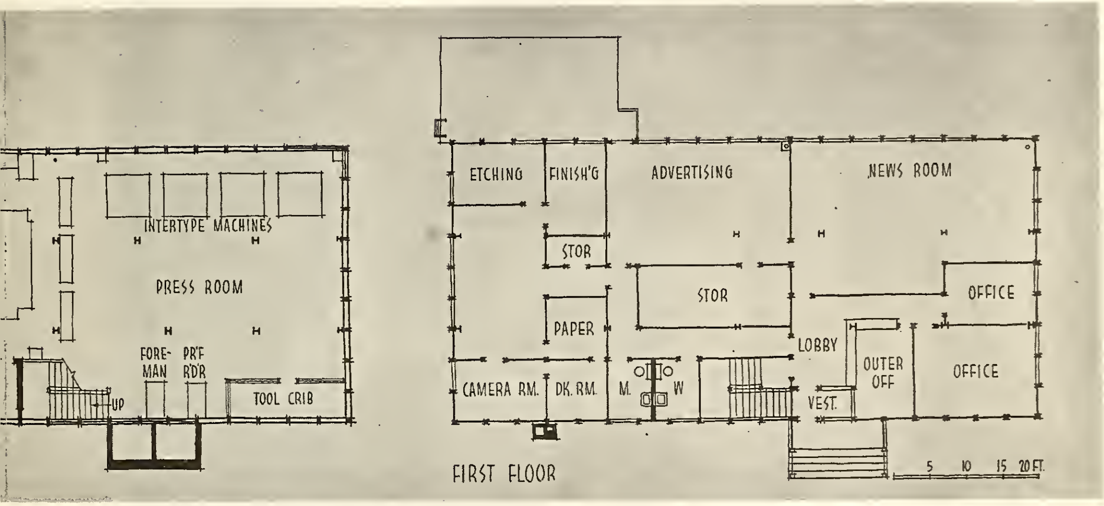
ST. JOHNSBURY, VERMONT

Whittier & Goodrich

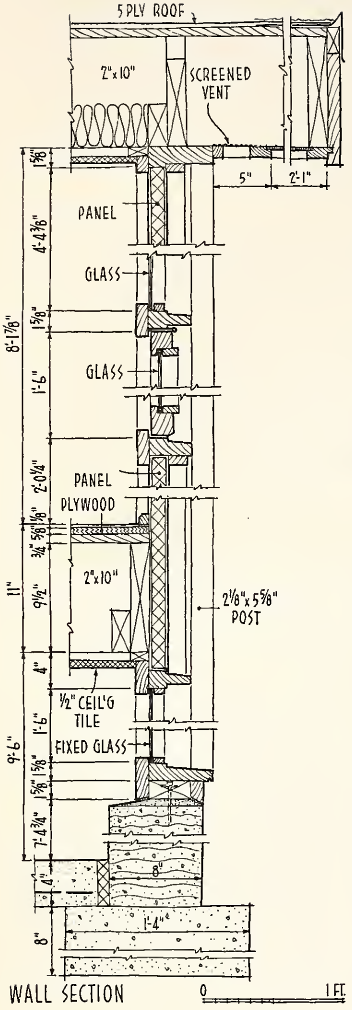
Architects

In the design of this small, trim newspaper plant, the architects were frankly experimenting with the use of modular coordination and inexpensive materials and detailing to lower construction costs. The plant is completely self-sufficient, providing every facility required not only for the printing and mailing of the paper itself, but for income-augmenting job printing as well. Within the economical rectangle of its exterior walls is ample room for the many departments required by a newspaper. Yet the building has no pretense about it; it blends happily with the surrounding Vermont countryside; and it gives unmistakable evidence of economic planning.

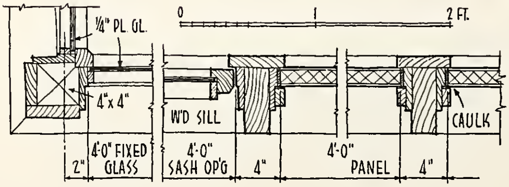
Foundations are concrete block, framing is steel with wood joists. Exterior walls and all interior partitions are cement fiber panels in modular sizes, which were used in conjunction with 4-by-4 verticals to achieve virtually complete modular construction. Floors are asphalt tile, ceilings are acoustic tile.

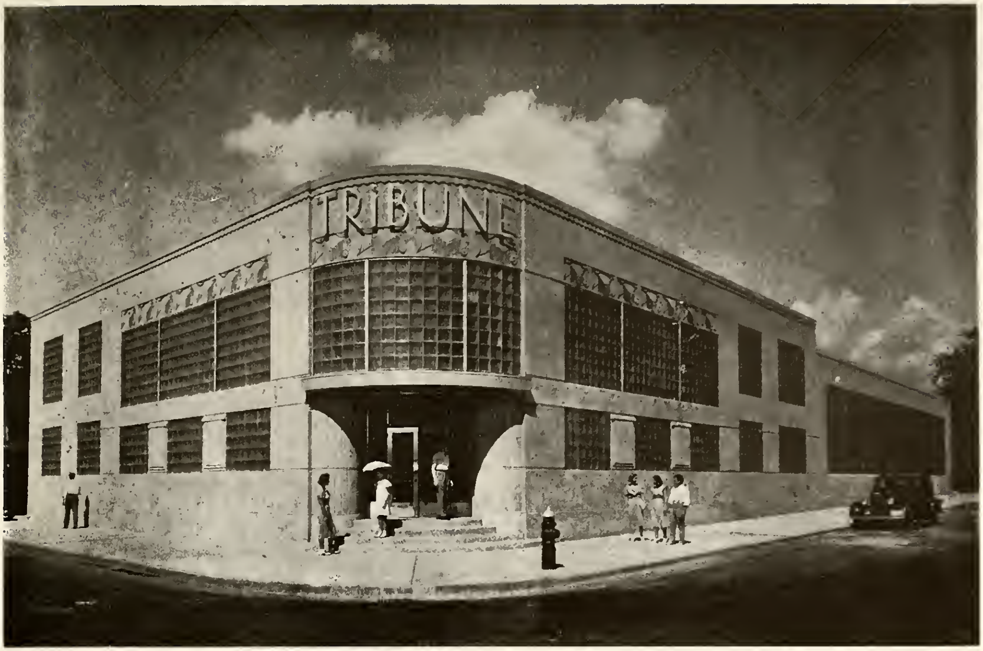


Opposite page: a sloping site was used to give building a seemingly one-story front (top) and two-story rear (bottom). The press room (center) is on lower level, handy to mailing room and paper storage, well lighted and well organized



Careful attention to detail is evident in wall and window sections above and right. Use of modular wall panels, standard posts and windows cuts down on construction costs without in any way detracting from efficiency and comfort of the building





NEW FREEDOMS FOR THE PRESS

NEWSPAPER PLANT FOR LA CROSSE, WIS., TRIBUNE

KRUSE & PARISH, ARCHITECTS

BOYUM, SCHUBERT & SORENSEN, ASSOCIATES

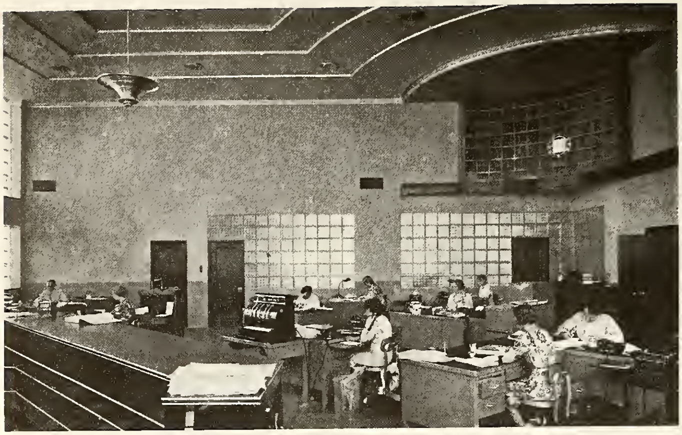
With its new building, functionally planned for efficient operation, this newspaper has achieved a still uncommon kind of freedom of the press. Since the manufacture of newspapers is a straight-line production job and a 24-hour operation, this space freedom is worth achieving.

The freedom in planning is plainly seen on the exterior. Glass block areas are virtual maximums permitted by varying room heights and interior walls, no effort being made to align them on the facade. For the rest of the exterior, it comes naturally from the reinforced concrete structure, with some masonry ornamentation in pre-cast concrete. Exposed metal parts and trim are of aluminum.

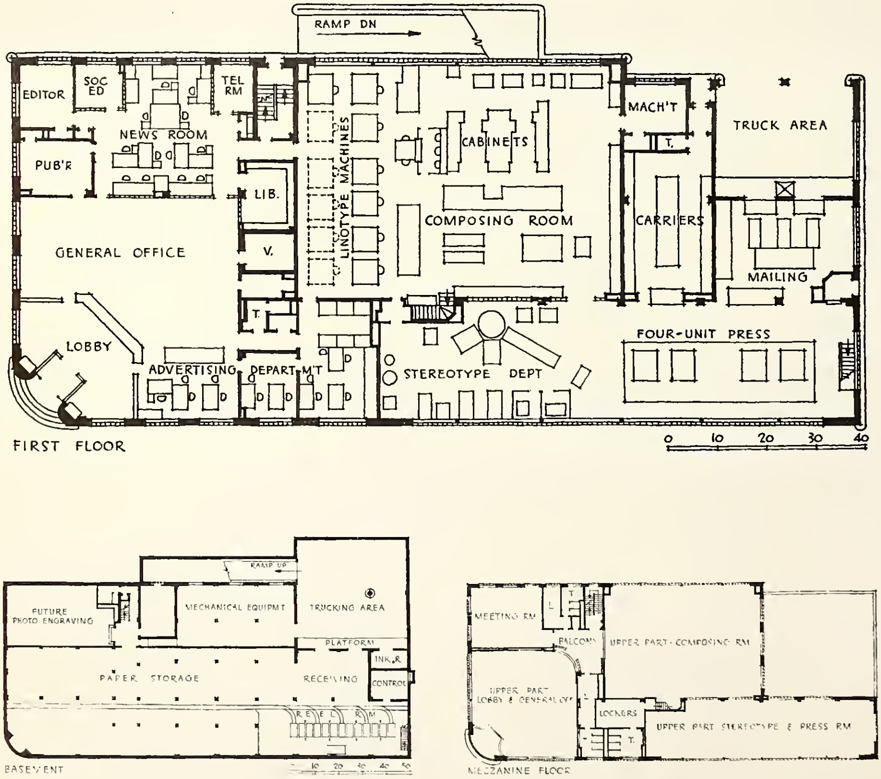
Freedom for handling heavy paper rolls and finished newspapers is gained by a double level trucking area. A public alley gives access to the upper platform for the newspaper trucks; a private driveway and ramp permits delivery of paper stock directly to the basement. Carrier boys have their own entrance to their separate room, and their own toilet room; thus is the rest of the plant protected from their excess energy.

Offices and newsroom are shielded from the noise and clatter of the operating departments by a row of "dead" spaces—stair wells, library, vault, etc. Glass block partitions and acoustic ceilings also help to isolate noise. Traffic between operating and office departments is minimized by supplying separate locker and washrooms.

Freedom for good newspaper work is further provided by a complete air conditioning system. While this is appreciated by the always-hurried white-collar departments, it is equally productive in the shop. Sufficient humidity is necessary to good, fast press work, and filtration keeps ink troubles under control. Earl H. Beling was consulting engineer for the air conditioning.



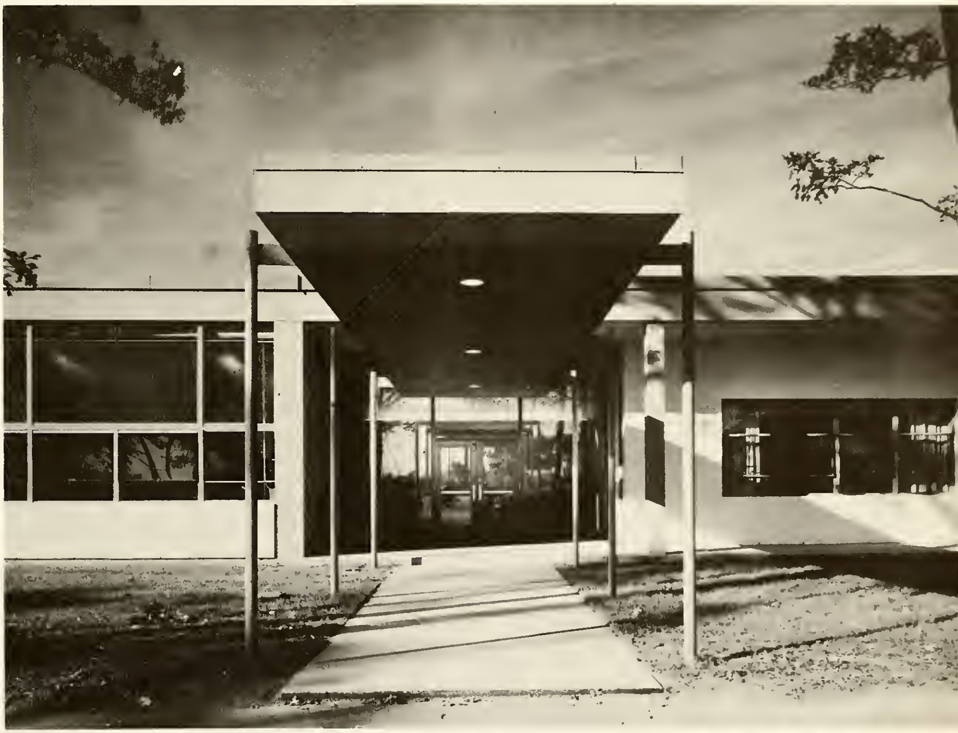
Lobby and office area is done with restraint, with high coffered ceiling of acoustic cork with aluminum bands and aluminum lighting fixtures. Woodwork is dull walnut veneer



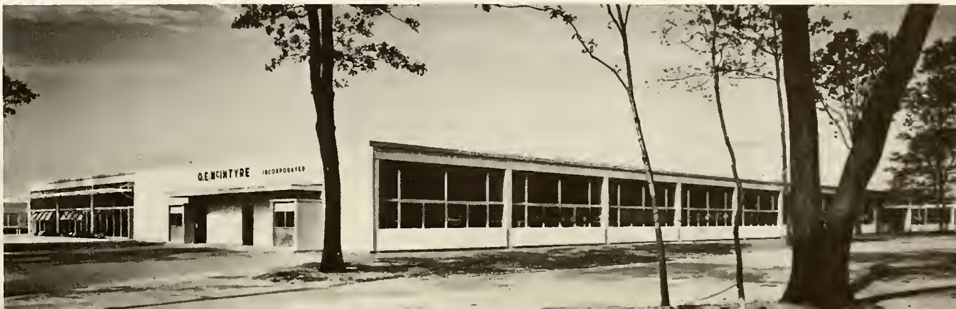
LIGHT, COLOR, OUTLOOK—FOR MORALE

Plant and Offices for O. E. McIntyre, Inc., Westbury, L. I.
Marcel Breuer and William W. Landsberg, Architects
Brown and Matthews, Engineers — Contractors

When a worker's task is repetitive, hence tiring, provision of a bright, cheerful environment can do much to heighten his spirit — thus his productivity. Owner and architects agreed on this idea and endeavored to realize it. Large glass areas yield adequate daylight inside; also look out generously upon a favorable site. The large trees there were preserved at every cost — even at the sacrifice of needed parking space. Primary colors were boldly used in production areas; typically, a 200-ft wall was painted bright red-orange against a surrounding foil of whites, light grays, dark grays. Yellow, red, and electric blue were similarly used. The terrace for luncheon and coffee periods was furnished with gaily colored umbrellas and beach chairs to contribute an almost festive note to the routine work-breaks.



Ben Schnall

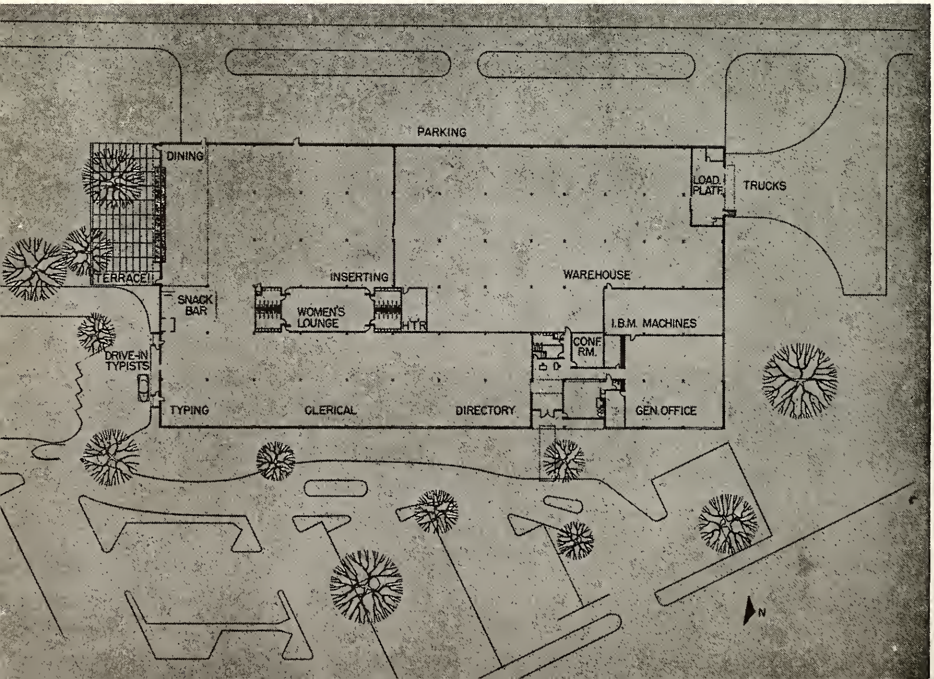


Ben Schnall

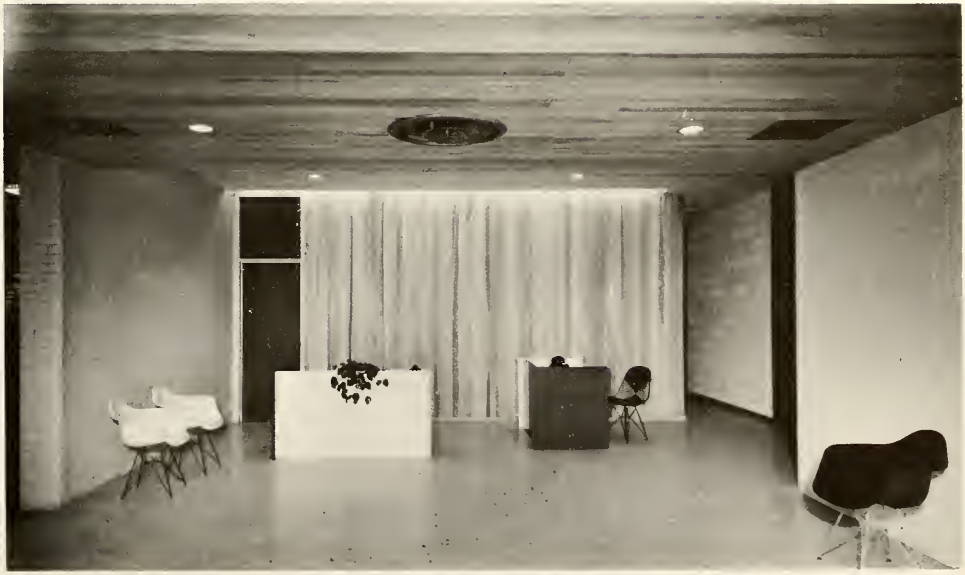
The nature of this business — not a common one — led to an interesting set of requirements. Engaged in direct mailing, the company needed areas for receiving and storing material, compiling address lists, inserting, addressing and mailing. A small Post Office occupies part of the area, so material leaving by truck is "in the mail."

Although there are 750 in the plant, additional help is recruited from among housewives in neighboring residential areas. Thus the drive-in section — arranged so part-time workers can pick up or deposit their work weekly in an easy traffic flow that saves time.

The business is growing so rapidly that a new plant of similar area is now under way. The completed building cost slightly over $7 per sq ft.

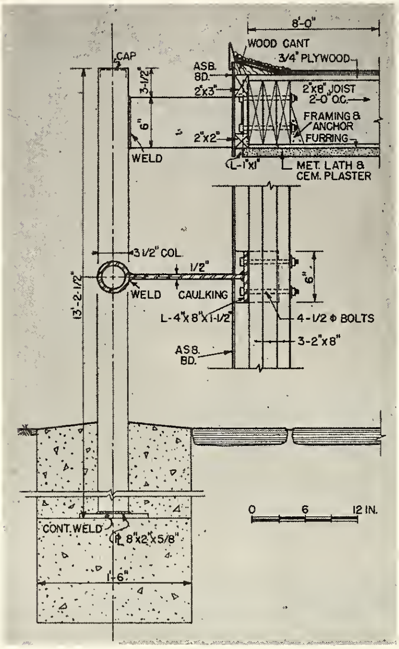


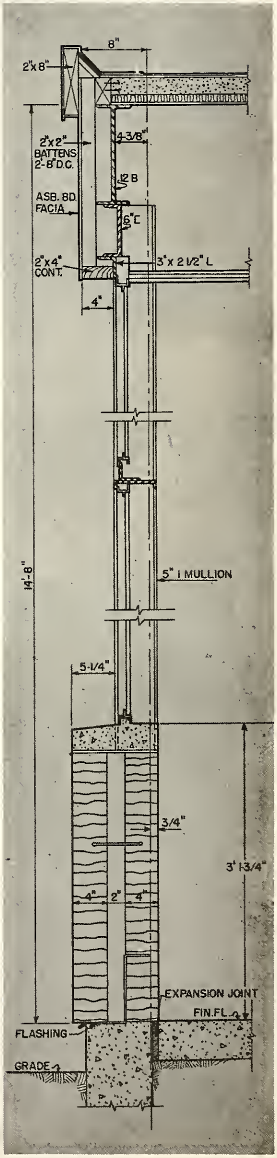
Below — the lobby as one enters: natural clear cypress; black and white confetti-patterned asphalt tile; white and light gray walls; plastic faced desks in blue, white, red, and black



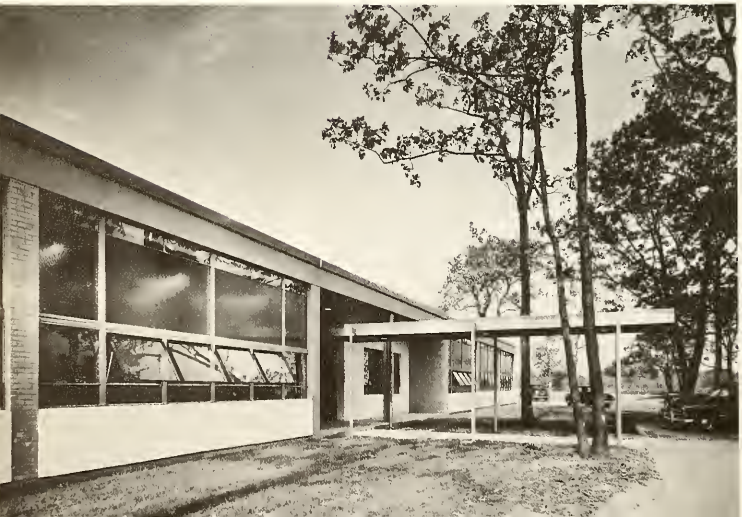
Unpolished plate glass is used in the upper panels to reduce sun glare in the daytime and to conceal after dark the exposed structure, wiring, and fixtures. The exterior is interestingly rendered: light gray column piers, fascia and fixed sash; black opening sash; white projecting block panels below. The marquee, shown in detail below, has a bright red soffit. The typical wall section shows how the usual reveals have been reversed to good effect.

O. E. McINTYRE





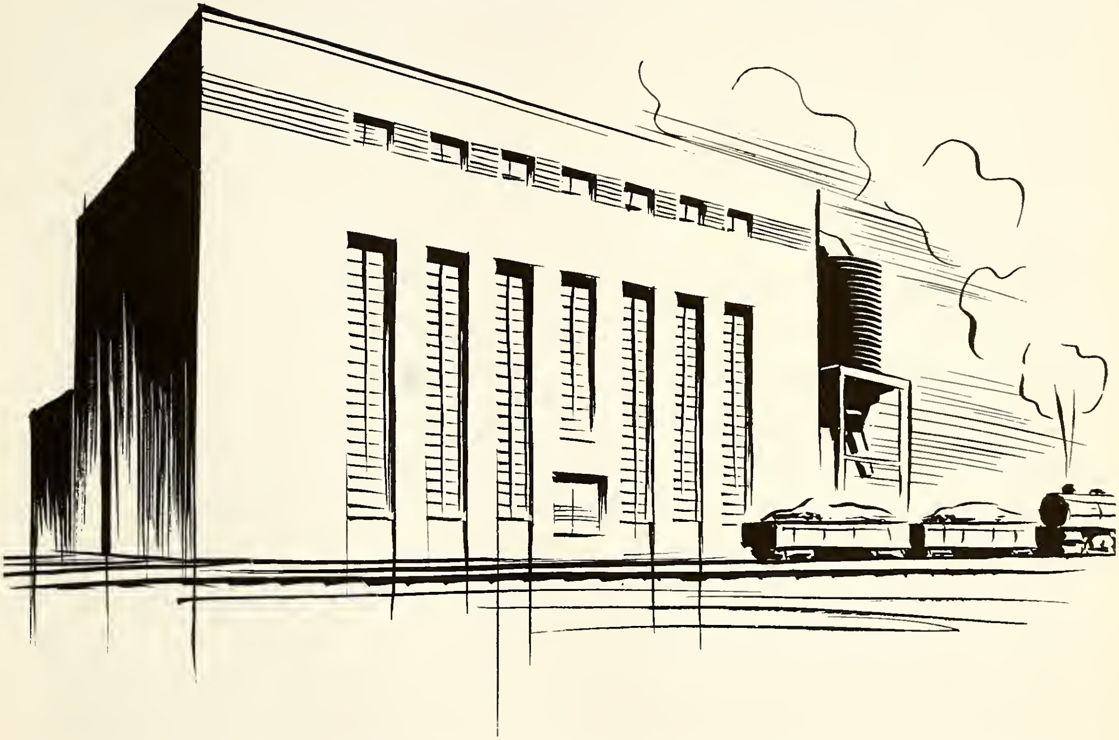
Ben Schnall



POWER PLANTS

Prepared in Collaboration with POWER PLANT ENGINEERING

ARCHITECTURE AND THE POWER PLANT
PROCEDURES IN POWER PLANT DESIGN
ENGINEERING IN POWER PLANT DESIGN
POSTWAR POWER PLANT SHOWS PROGRESS



Anybody inclined to worry over the architectural future might just pause to remember the many types of buildings which in recent years have emerged from a back-alley limbo into the realm of enlightened design. Power plants are a notable example, as this collaborative study bears witness. Perhaps design improvement came from the inside outward, starting with technical advancement in methods and machinery, and finally getting mixed up with those intangible but powerful considerations of pride of workmanship and of ownership. At any rate, power plants now offer further proof that industrial progress always demands more and better design.

This editorial collaboration with *Power Plant Engineering* testifies to the recognition of that fact in technical as well as architectural circles. Engineers know something of good design, and they like it. And they find a nice parallel between logical layout, well chosen materials and finishes and inspiring appearance on the one hand, and good operating results on the other. Thus ARCHITECTURAL RECORD and *Power Plant Engineering* join in presenting some advances in technical and architectural design, to a joint audience representing ownership and operation as well as design.

ARCHITECTURE AND THE POWER PLANT

By F. A. Fairbrother, Associate

Albert Kahn Associated Architects and Engineers, Inc.

As the power house is such a vital element in any industrial enterprise, it is entirely fitting that it be treated architecturally with the dignity and respect due its importance. It must be remembered that the power house is very close to the heart of the manufacturing operation, and should thus be especially close to the heart of those responsible for the success of the whole enterprise. That it works this way is well known to any architect or engineer who has attended the final inspection of a well designed, clean, efficient plant. The pride of the owners and their operating engineers is very evident; one will hear enthusiastic discussions of even such details as interior finishes and color schemes.

Sometimes the power house or boiler house has been quartered in a very unprepossessing structure, and we believe it would follow naturally that results from operations would likewise be uninspiring. Considerations of pride, esprit de corps, and of emulation permeating all departments should result in the provision of adequate, commodious and well designed space for this department.

The architect specializing in power houses must, of course, condition his thinking to the fundamental economic purpose of the project immediately on his drawing board. The profit motive is the sole reason for its being, and the architect who adds unnecessary cost for the sole purpose of architectural embellishment is not doing his best either for his client or for himself. It is, however, a tenet of this organization and its founder that the proper study of proportion and mass, the suitable choice of materials and proper placing of openings will lead to a successful architectural result with little need of applied embellishment. The cost of the buildings so studied has been found in our experience to be no greater than for those on which no care has been given to design.

Within the broad confines of economic and technical restrictions is a wide opportunity for individual initiative and ingenuity in achieving balance and harmony with the properties at hand.

It has been said that one cannot do much, architecturally, with a coal pile. But the same coal stored within the building, raised to the proper height in a coal bunker and housed in a well designed exterior will become a vital and interesting feature of the building. Similarly, equipment which cannot feasibly be housed within the building, such as ash storage silos, air receiver tanks, cooling towers, overhead pipe bridges and like items, cannot by any stretch of the imagination be thought of as beautiful. The power house architect must regard them as a part of the whole conception of power production. He must try honestly to mitigate the stern necessity for their presence by a careful attempt to locate them in proper harmony to the whole and to play up such features as may contribute to a well proportioned ensemble.

To accomplish such a commendable result requires the combined efforts of both the designer of the power house as an efficient mechanical instrument, and the architectural designer seeking for harmony of mass, color and texture.

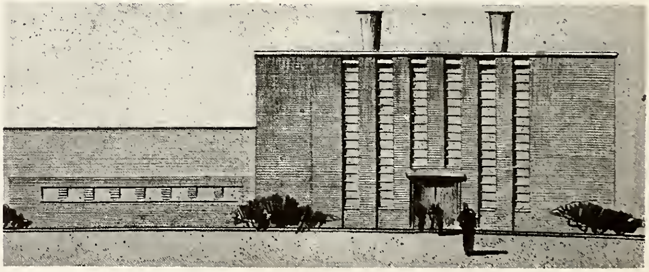
The interior of the power house is not a place to indulge in "architectural" features. The finest sort of utilitarian equipment, however, being of most functional use and character, is also good architecture. The greatest interest, of course, within the power house will be the equipment.

The interior walls can be treated with light and easily cleaned surfaces. The usual thought must be given to the study of proper proportion and of interesting and practical materials.

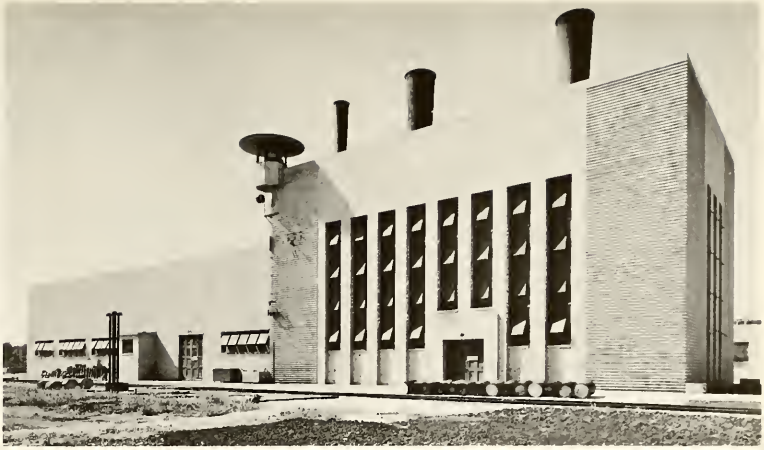
One question certain to come up in any discussion of the postwar trend in industrial architecture is the matter of window versus windowless plants, particularly power houses. Certainly as many (and probably more) power houses have been built with windows as without them. To this writer there appears no good reason why these buildings should not have windows, and many times both interior facilities and exterior design would seem to require them. However, large areas of inaccessible windows, lighting only the upper levels of boiler-room walkways or coal bunkers, would seem of little value.

Blackout restrictions imposed early in the war dictated many cases where windows had to be omitted, and I do not believe it would appear from an examination of illustrations in this special section that the architectural design of power houses suffered from this limitation. It will be noticed that in some cases we built in window openings and blocked them in, so that sash can be installed after the war.

Whether power houses in the future will be built with or without windows will depend largely on the trend in the entire manufacturing area. Some research experts foresee the entirely windowless plant taking precedence



Hedrich-Blessing photo



Power plant for the Amertorp Corporation Forest Park, Ill.

in the not distant future. The Albert Kahn organization has taken no arbitrary stand on the question. There are human factors involved which have not yet been properly weighed. There certainly are psychological reasons why some glimpses of out-of-doors would be desirable.

Louis Kahn, head of our company, tells an interesting story about the labor reaction to one blackout plant we designed and erected to government order. The plant was opened in mid-winter and there was little employee reaction to the opaqued windows. But in the first balmy days of spring, window breakage went up alarmingly during the dayshift hours. Special vigilance disclosed that whenever a guard's back was turned, a man at the bench would pick up a wrench or other heavy object and hurl it through a window. They wanted the feel of that outside air. The human equation is having a constantly greater influence on the trend of industrial architecture. Another new influence is the airplane.

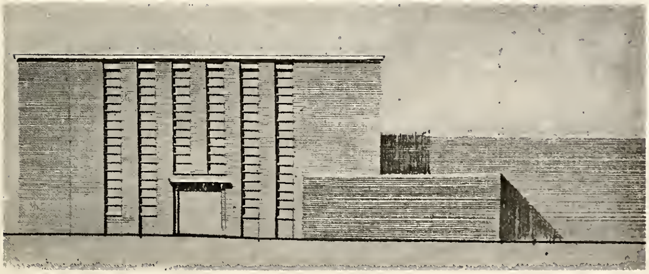
The tall masonry or steel stack has been replaced in many cases by shorter, funnel-shaped, induced-draft stacks. A certain element of strength seems lost when one of the typical and certainly most functional features of the power house is missing. Practical considerations dictate such matters. It is, of course, necessary that tall stacks be eliminated in the vicinity of airfields.

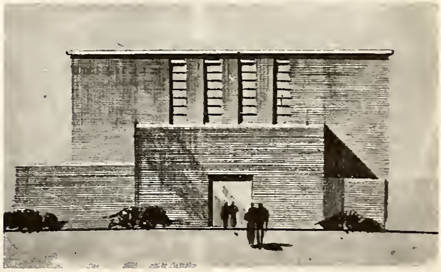
It is true that some of the operations enclosed in the typical power house could be successfully carried out in the open, for example the oil refinery and its maze of stills, tanks, balconies and ladders. But it is equally true that compressors, turbines and other equipment of a like vulnerable nature cannot be left out at the mercy of the weather.

Inasmuch as we must have a power house building, it is well to include within the walls as much of the equipment as can properly be installed there. Some items of equipment, on the other hand, often cannot feasibly be given space within the building. The architect must be content to dispose of them in as reasonable a manner as circumstances will allow.

In spite of the repetitive character of features making up the usual power house, opportunities for originality in the design studies of these problems are not by any means exhausted. An interesting problem was presented in a power house built recently as part of an industrial plant in the south, and a few of the sketch studies for this building are shown herewith. Rough studies of the sort shown, made quickly, help immeasurably in development work.

The whole trend of industrial architecture, it seems to me, whether power plants or the general manufacturing area, will be influenced by so many variable factors that any arbitrary predictions and definitions are pointless. Those industries which have given industrial architecture its greatest impetus have always been characterized by an open mind. That is an attitude commended to every man in this profession.





PROCEDURES IN POWER PLANT DESIGN

By F. A. Fairbrother, Associate

Albert Kahn Associated Architects and Engineers, Inc.

Design of a power house must be considered as a cooperative enterprise between the architect and the power engineer, and the closer the cooperation can be, the better will be the result. The architect will understand, of course, that in power plant work he will not have much freedom in the sizes and disposition of forms and masses. His task is to house a multitude of large and complicated equipment, and his work will go smoothly only if he coordinates it fully with that of the power engineer.

In our own organization the preliminary layout of the power house and its equipment is the responsibility of the power division of our mechanical department, since here we have worked together for years, and we know the power engineers will consolidate their ideas into a form that can be developed into a reasonable building.

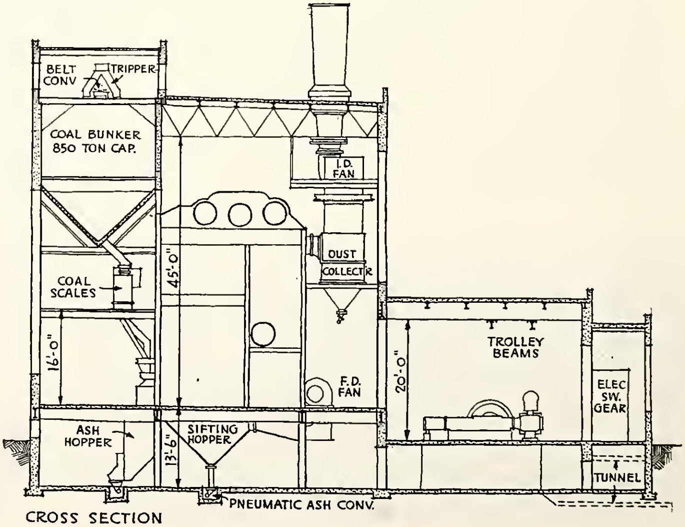
It would seem that it is of great advantage to have the department charged with such layout an integral part of the whole organization, as it enables the different department heads to confer at will and not be dependent on occasional interviews as would be the case if the work were carried on by separate organizations.

Together this team (architects and engineers) will confer with the client's plant engineer to learn just what is desired, and to decide on the types of boilers, blowers, compressors and mechanical handling, etc. In some cases, also, the refrigeration units will be installed as part of the power or boiler house units.

From this conference the engineer will prepare estimates of cost of the recommended equipment, together with sketch plans and sections showing the arrangement and clearances required for the proper functioning of the equipment and from an operational standpoint. The architect up to this point has had little to do with this preparatory work, but he will now confer with the engineer and consider the necessity of the different requirements as outlined. The architect in general will accept the engineer's recommendations, unless he sees a conflict with the plant's future development, difficulty in bringing in oil and services, or feels that the location can be improved for better functioning. Minor changes can be made, but in general the architect will design the building along strictly functional lines.

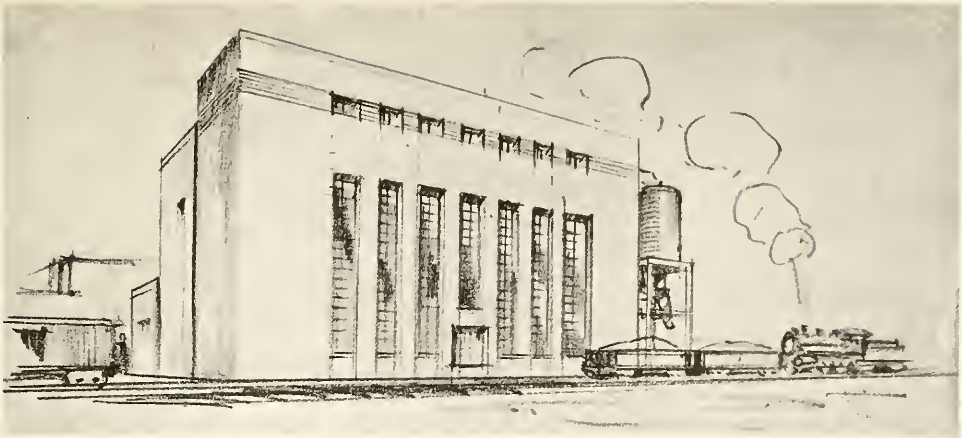
A perspective should be prepared and estimates made of the completed structure, including all trades and equipment. It is well at this stage to prepare comparative costs for oil and coal to be submitted for the owner's approval. The plant engineer is thus able to give his approval and the "go-ahead" for the work. It is now the duty of the design engineer to send out plans and specifications for equipment bids, and until such equipment is actually purchased there is little more the engineer or architect can do. So much variation will be found in the size and types of boilers, stokers, oil burners, pumps and compressors, generators, etc., that it is not feasible to make working drawings for such a building until the equipment is purchased and drawings for the equipment are in hand.

It sometimes happens that such pressure develops to get ahead with working drawings of the power house and to try to fit the equipment in afterwards, that the attempt is made. This may be because preliminary bids must be taken or other factors are compelling. The result is always the same. So many changes are required that the plans must be practically made over, and the office budget for getting out the job takes a severe wallop. Such conditions were especially prevalent on war jobs where used equipment had to be installed.



CROSS SECTION

Architectural design begins when the power house equipment has been decided upon; in fact Kahn designers usually wait until the equipment has been bought. Here are plan and section, prepared in the Kahn office by the power engineering department, which delineate the planning problem for architectural designers. Some changes can be made for architectural orderliness, but these drawings set forth the basic problem.

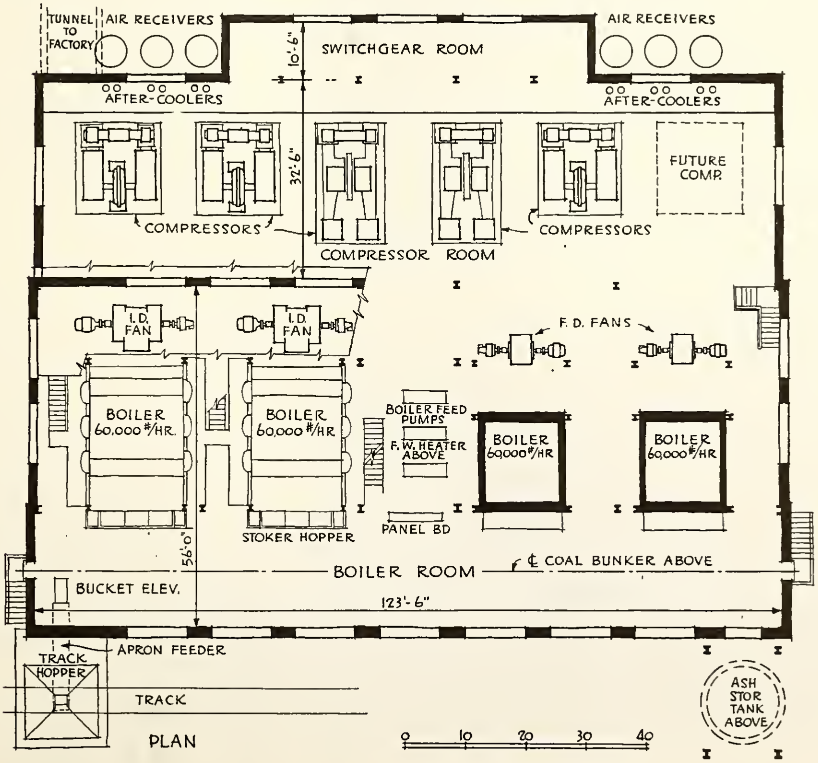


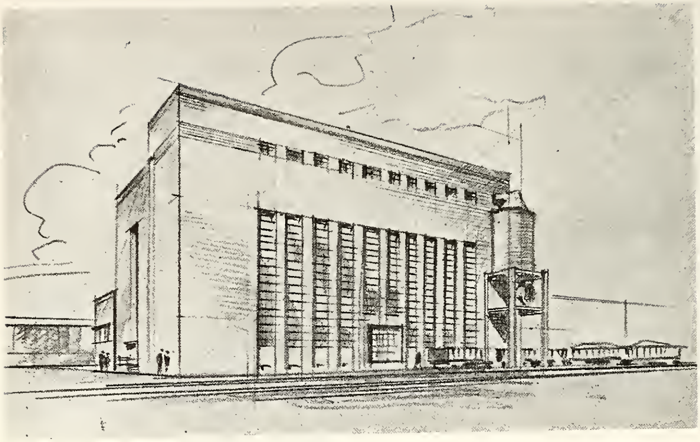
One of the preliminary studies for the postwar power plant shown in plan and section below

It is easy to see why bids must be taken for equipment even before starting working drawings for the building.

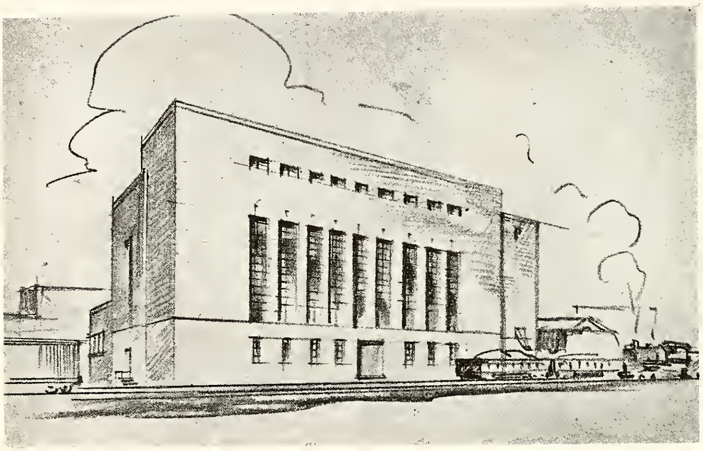
Meanwhile the designers' room is busy making studies of the building, developing proportions in mass, fenestration and detail. These studies will involve, of course, further consultations with the power department to find what leeway may exist in changing room dimensions.

Shown herewith is the plan and section of a project as laid out by the power department. It will be noted that they have indicated walls and windows, some general sizes, but especially have shown control dimensions for heights, clearances, etc., which must be observed in developing

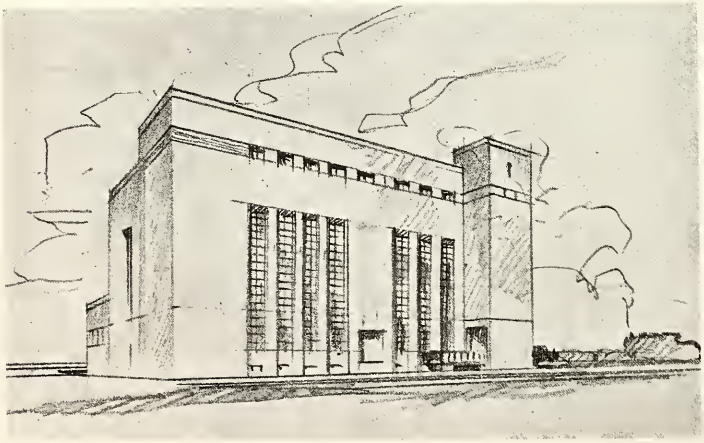




Kahn architectural designers, having received a basic plan and section from engineering department, make several quick sketch studies, to check disposition of masses and to study fenestration schemes



Here the architectural designers get really tough about the ever-present ash storage tank, and block it in at the side of the building behind brick walls. They also try different arrangement of windows



Still another disposition of the ash storage tank, this time in a tower jutting out in front, where the tank logically wants to go. They try this one to see how the fenestration might be arranged working drawings. These drawings serve also as the means of obtaining approval of the proposed layout by client's engineering and operating staff. From these drawings of the plan and section as laid out by the power department the designer makes subsequent rough studies and free hand perspectives and details, as the elements of the design become clarified.

As the equipment to be used is decided upon it becomes possible to establish definite clearances for boiler framing, supports and framing around compressors, provision for drawing tubes and shafts, etc. At the same time further detailed drawings for piping, installation of equipment of various sorts are being made by the power department, and the job captain in the drafting room has his crew under way with the working drawings.

Many details must be considered in the preparation of working drawings where moving equipment is to be installed. It must be possible to get the equipment into the structure and equally possible to replace it if necessary because of failure or obsolescence. It must be possible so to arrange moving equipment that vibration is not imparted to the structure. Therefore expansion joints, open or filled with a suitable non-extruding material, must be provided around the bases supporting such equipment.

An excellent method of treating the bases of equipment, especially where they project above the surrounding floor level, is to provide a black terrazzo finish on the sides of the bases and a border with a cove at the junction. The border may be made of the width necessary to fit the pattern of the adjacent finish of the floor, such as quarry tile. This material we have found excellent for the floors of power plants, even around the boilers, because the modern plant is far different in operation from the old-fashioned kind as dust and grime are missing.

The personnel employed in the boiler house must have office and locker space, toilets and shower rooms. While dirt and dust from the handling of coal and ash have been eliminated, still repairs must be made and maintenance must be constant. A maintenance shop is usually required, with a certain amount of shop equipment.

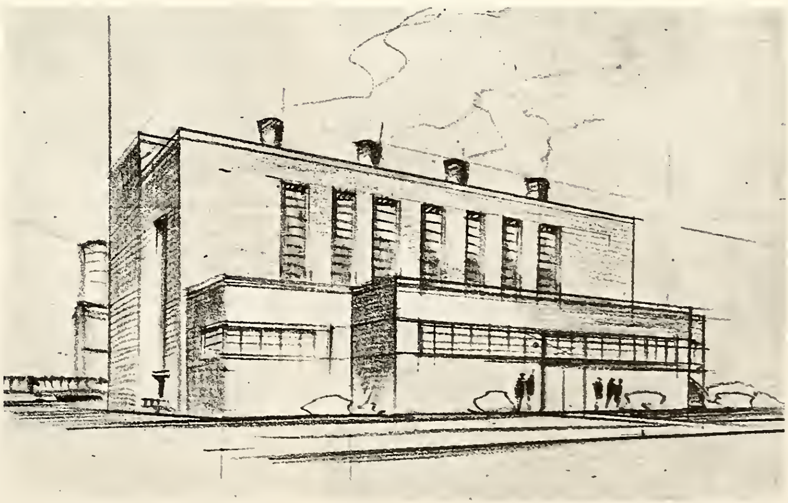
If windows are provided in the building most of the ventilation may be taken care of by them. But in the case of blackout buildings some mechanical means must be provided. In either case enough incoming air must be made available for replacing that drawn out through furnaces and stack; otherwise combustion will be starved. Moreover, excess heat must be removed from the upper parts of the building, either by windows or by louvers. Inasmuch as large quantities of air are exhausted from the upper parts of the building, cooler air will be drawn in below. Therefore some heating must be provided in lower areas where men are at work.

The power plant and the rest of the industrial plant are (or were, prewar) strictly masculine institutions, and should so appear in the straightforward functional character of their design. Therefore, one would find normally little chance to practice "design" in the interior of the power plant. This does not, however, preclude the use of suitable materials well placed.

The color of wall surfaces both of paint and glazing can be both functional and attractive. Bands of color well used in the walls, either as wainscot or otherwise, and in the equipment can be in harmonious contrast. Studies of the color of machinery as affecting the work and safety of the employees have been found of great value, increasing visibility, efficiency precision and minimizing accidents. Colors indicating relative dangers or uses of areas have been standardized.

It has been found wise wherever possible to provide stairs rather than ladders between different levels of the service walkways around boilers and other equipment. Ladders, of course, must sometimes be used, and we have made a practice of providing hoop enclosures around them to prevent falls. Railings must be provided around stairs and walkways. Wherever upper-level working platforms or walks are provided they are built with a curb or other guard to prevent tools being pushed off or dropped on persons below.

The rear elevation also comes in for its share of study in the preliminary stage



ENGINEERING IN POWER PLANT DESIGN

By F. K. Boomhower
Chief Engineer, Mechanical and Electrical Departments
Albert Kahn Associated Architects and Engineers, Inc.

From the early days of the industrial power plant, there has been steady progress in the development and efficiency of steam and power generating equipment, and continual improvement in the structural and architectural design of the buildings that house the plants. Old time plants were usually crowded, little or no thought being given to the possibility of expansion. Lighting was given minimum attention. The plants were necessarily dirty because of the methods of handling coal and ash; no attention was given to the comfort of the operating crew—that was not considered necessary. The plant structure was merely an enclosure to provide protection from the elements for the equipment. The plant was usually something which just grew and was treated as an unwanted necessity.

The client of today, however, has an entirely different point of view toward his power house plant. He expects, of course, the latest steam and power equipment, but he also expects refinements in the building. He must have ample space provision, light, easy access to all parts of the building, locker rooms, and other facilities for the operating crew, an office for the chief operating engineer, and a small laboratory for checking the treatment of water for the boilers. Today the labor unions have their say about power plant design, and recently have been in a position to dictate to a certain extent the physical conditions in the plant in which they will work.

The engineering features which enter into the design of a boiler or power plant for the modern industrial building are quite numerous.

Location of the Power Plant

The design of the power plant starts with a study of the most suitable location within the property lines of the industrial plant site. The principal factors entering into this decision are: (1) the availability of a railway spur line; and (2) suitable space for fuel storage.

The spur line in question is separate from that serving the factory areas; there should be a line intended exclusively for the delivery of coal or oil to the power house. It must be adequate to hold both loaded and unloaded cars without the necessity of switching to permit the spotting of cars required for other purposes.

The storage area must be adjacent to the boiler house, so that the fuel, if coal, may be easily stored and reclaimed. If the fuel is oil, there must be sufficient tank capacity either above or below ground, in compliance with requirements of the National Board of Fire Underwriters.

Another factor to be considered is the location of the plant with respect to the manufacturing buildings. While this relationship affects the length of piping and other service lines, a still more important factor is the usual connecting tunnel. Naturally economy dictates the shortest possible lengths.

In some instances there will be another location factor: the direction of prevailing winds, particularly if the plant is very close to residential property. Regardless of the design of or the equipment installed in a plant, a certain amount of soot or fly ash will be emitted from the stacks, which at times is objectionable. The escape of soot from a stack caused by blowing the boiler tubes has frequently caused trouble, unless the plants have dust collecting equipment. In general, however, the direction of the prevailing wind is not a major factor. Speaking of soot, it is important that any aerial high tension lines or outdoor substations be so located that the products of combustion will not pass over the insulators, as there is some danger of shorting and breakdown due to the coating of carbon particles which will accumulate on the surface of the porcelain when it is moist.

Selection of Boilers

After the location has been chosen comes the study of load conditions in the plant. Both the maximum and the minimum steam demands are calculated. Included in the steam demands, besides those of generating equipment, will be heating requirements of the building served, the process steam load, water heating, and perhaps other uses for steam. When these figures have been assembled, the size and number of boilers are determined.

A prime consideration in the size of the boilers is the requirements at minimum load. It is customary to select a boiler size so that at the average minimum load one or more boilers may be operated at good efficiency. With the size of the boilers thus determined, the maximum demand then establishes the number of boilers required. Since the efficiency curve of a steam generating unit is quite flat from two thirds to full capacity, the designer will usually find ample range in the selection of boilers so that three or four units may be found suitable.

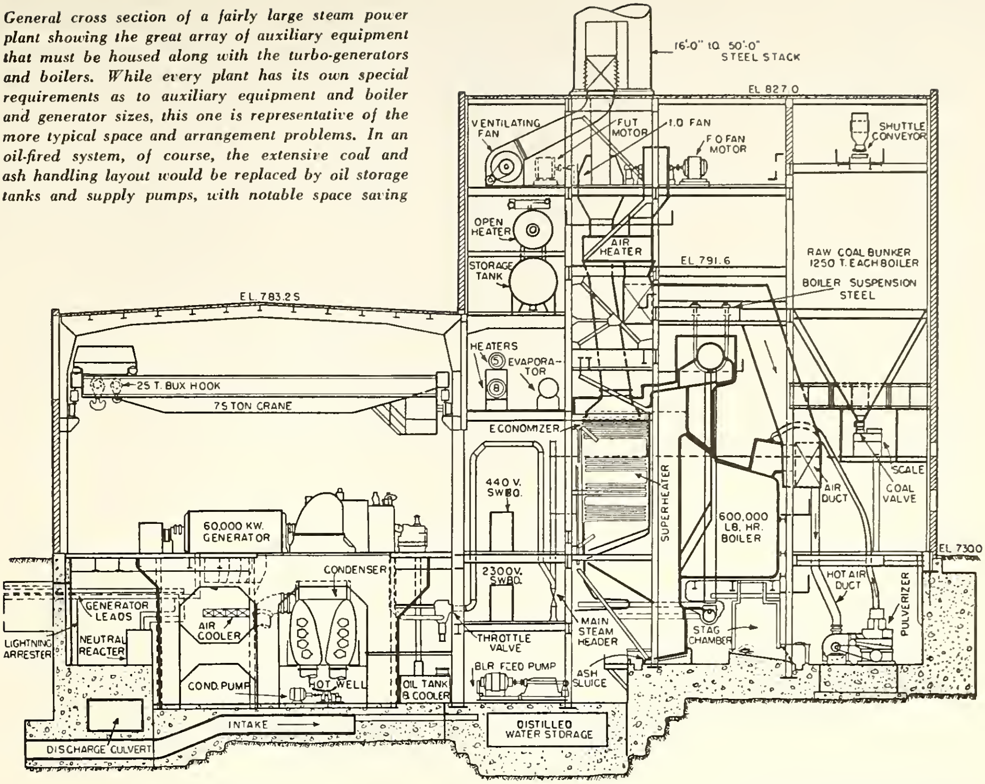
As part of this process, consideration should always be given to the possibility of future expansion, as it has been the history of nearly all industrial projects that they increase in size and output, requiring increased output from the boiler plant. Many plants have been erected without apparent thought to this possibility; the inevitable result is distorted design, ugly external appearance, and generally a makeshift interior arrangement conducive to indifferent and inefficient operation. There are other considerations entering into the provision for future expansion, having to do with equipment, mentioned later in this article.

Choice of Fuel

Next comes the selection of the method of firing the boilers. There are three types of fuel in most general use: oil, coal fired with stokers, or pulverized coal. While the design is naturally based on engineering economics, with due consideration for the preference of the owner's operating engineers, there are many factors which enter into the design of the boiler house itself.

With oil firing the problem of fuel storage and transportation is simplified, as the only fuel handling equipment required consists of pumps and piping. No space is necessary below the boiler room operating floor, there is

General cross section of a fairly large steam power plant showing the great array of auxiliary equipment that must be housed along with the turbo-generators and boilers. While every plant has its own special requirements as to auxiliary equipment and boiler and generator sizes, this one is representative of the more typical space and arrangement problems. In an oil-fired system, of course, the extensive coal and ash handling layout would be replaced by oil storage tanks and supply pumps, with notable space saving



Courtesy Power Plant Engineering

no ash to be removed, and a minimum of soot is discharged from the stacks.

When coal firing with stokers is found advisable, the most suitable design requires a space below the firing floor, in which are placed the ash hoppers, wind boxes, siftings hoppers, ash removal equipment, and a part of the coal conveying machinery. A suitable height for this space in the usual industrial power plant is 14 ft. from floor to floor.

A coal bunker is required from which coal is delivered to the stokers or pulverizers. This is placed above and in front of the firing end of the boilers. As a provision for possible future expansion, the bunker should extend along the outer wall of the building. This arrangement permits a comparatively inexpensive increase in capacity by the addition of a second row of boilers facing the first, both rows supplied from the original bunker and forming a central firing aisle.

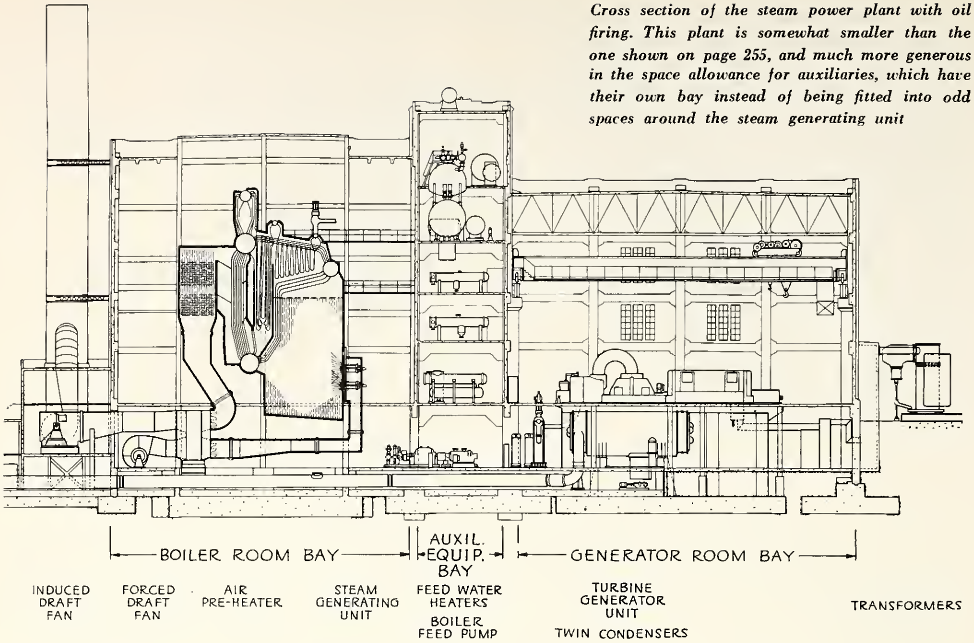
The Size of the Boiler House

The boiler house plan should also provide for future expansion, beyond the addition of the second row of boilers, by addition to the length of the building. Thus all obstructions such as track, coal hoppers, and ash storage tank should be so placed, if possible, as not to interfere with either side or end expansion.

Another major element in determining the size of the boiler house is the overall space requirements for auxiliaries. These include feed water heaters, boiler feed pumps, water treating equipment. Forced and induced draft fans may also be required if the old tall chimney is eliminated in favor of the modern low stacks. There should also be a space allowance between the boiler settings and the end walls of the building.

Cost factors may require that the expense of a coal bunker be excluded. In this case, coal will have to be stored outside the boiler house, perhaps in one or more coal silos built adjacent to the building, to which coal may be delivered from the cars, stored, and then delivered to the stoker hoppers by coal handling machinery. This method alters the boiler room design by the removal of the overhead bunker and reduces the first cost of the structure. It does, however, involve double handling of the greater part of the coal in the silo by the elevators. Moreover, in cold climates the coal, if sufficiently moist, is subject to freezing. Consequently, there will be difficulties in handling in the silo and in the conveyor delivering coal to the boiler room. This method of storing coal alters the design by reducing the maximum height of the building.

If a chimney tall enough for natural draft is to be installed, it will usually be found advisable to superimpose it on the building framework at the roof line. This method is desirable not only from the standpoint of first cost, but also to improve the neatness of the design and the general accessibility. These considerations hold regardless of whether it is constructed of self-supporting steel or brick.



Cross section of the steam power plant with oil firing. This plant is somewhat smaller than the one shown on page 255, and much more generous in the space allowance for auxiliaries, which have their own bay instead of being fitted into odd spaces around the steam generating unit

Other Elements of the Power Plant

Even though the factory may purchase its electrical power, the power plant will usually include one or more of these other major equipment items: (1) Power generating equipment; (2) air compressors; (3) air conditioning equipment; (4) control boards and switching equipment.

In most of our large wartime industrial plants, electrical power is purchased from outside; thus the "power house" is technically better known as "boiler house." Instead of the electric generators, then, there will be merely a transformer substation, usually placed outdoors.

In practically all cases, however, there is a sizable installation of air compressors to supply compressed air to the factory. Air compressors are usually housed in the boiler house in a section immediately at the rear of the boilers, and arranged in a row either parallel to the boilers or at right angles to them. The latter arrangement is sometimes more desirable if air conditioning is to be included. Locating such equipment in the boiler house is advisable because the operation and maintenance are naturally a part of the duties of the operating engineers. Naturally this work can be done better, and with fewer men, if the equipment is located in the boiler house rather than in some remote part of the manufacturing building.

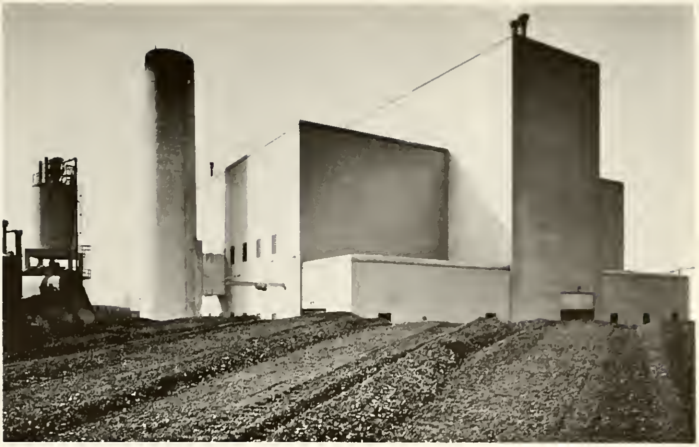
Compressors or other heavy reciprocating machinery should be placed as near grade level as design conditions will permit, so as to avoid vibration and still use a minimum of concrete foundation. The compressor section should be designed with sufficient height to permit the installation of a traveling bridge crane for the erection and maintenance of the equipment. The crane must have a hook clearance above the floor sufficient to lift and move the heaviest piece; this will usually be about 18 ft. This requirement of course governs the height of the compressor room roof.

Air conditioning equipment, still a relatively new development for the large factory, has altered considerably the design of industrial power plants. While air conditioning purely for the physical comfort of the employees has not often been permitted in wartime plants, it is frequently necessary to improve manufacturing conditions, where uniform temperatures should be maintained for the sizing of major parts of steel, aluminum, or magnesium to fairly close limits. Air conditioning frequently involves the installation of refrigerating machinery with capacities up to the equivalent of the melting of 8,000 tons of ice per day.

Air conditioning equipment is commonly located in the air compressor section of the boiler house, where it also will be under the care of the boiler operating crew. The installation usually requires floor space on two different levels, the upper level having a traveling bridge crane of perhaps ten ton capacity.

An idea we have frequently used is to omit the usual partition between the boiler room and the compressor room. It is entirely possible to design the ash and coal handling and burning equipment so as to prevent the escape of dust. Boiler room dust was of course the reason for the partitioning between boiler room and compressor room. With oil firing this problem never was a factor.

A partition, while requiring floor space equal only to its thickness, usually will be found to require some two to four feet additional, and interferes with free access between the boiler and compressor sections of the building, and with the ventilation of the boiler room.



Hedrich-Blessing photo

Stacking coal, at the Wright Lockland plant, to prevent spontaneous combustion. It is leveled off and packed down by bulldozers to keep air from reaching inside of pile

Modern Methods and Equipment

The modern boiler does not have the solid heavy brick wall construction of the earlier one. It has insulated refractory walls supported by cast brackets mounted in sections on structural steel shapes. The walls are cased on the outside with steel or asbestos cement plates and cooled by natural or forced air circulation. The refractory faces of the settings on the furnace side are protected by steel tubes in which water circulates as a part of the boiler water system. Furnace design has developed to a point where the maximum permissible heat release from the burning fuel, in Btu. per cu. ft. of furnace volume, is quite definitely known for the various kinds of fuel and methods of firing.

Steam pressure and combustion are under automatic control to maintain uniform steam pressure and the highest average efficiency with variable loads. Feed water level in the boilers is also automatically controlled. Motor or turbine driven centrifugal pumps feed water to the boilers at a temperature of 225°. Feed-water heaters eliminate the dissolved gases such as oxygen and carbon dioxide, to avoid corrosion of the internal steel surfaces of the boilers as well as of the steam and condensate piping.

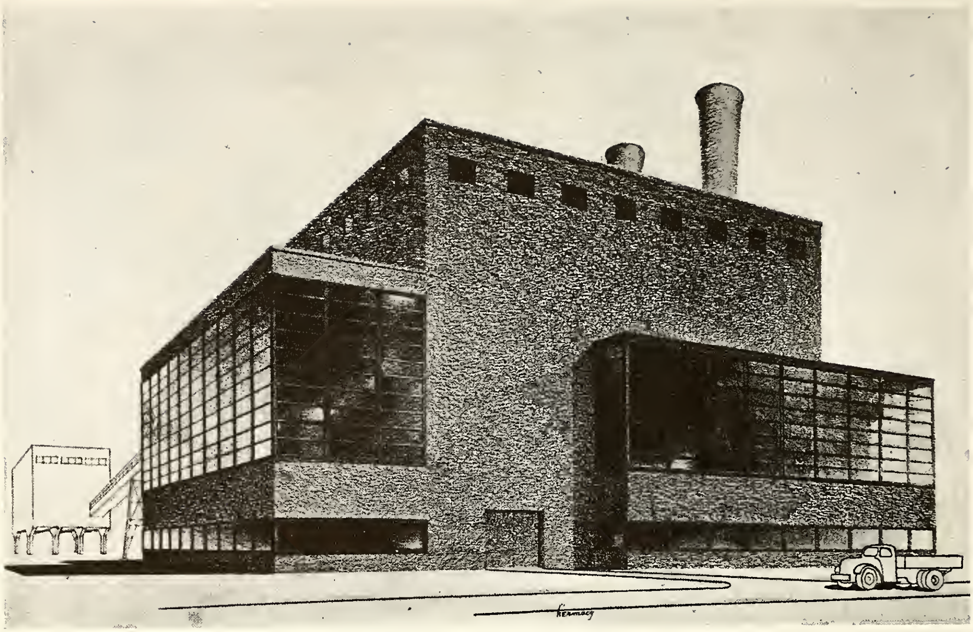
Manual handling of coal has been entirely eliminated. Coal is handled to and from a stock pile and to overhead bunkers or silos and to stokers by modern coal handling machinery.

Spontaneous combustion in coal storage or stock piles has been virtually eliminated within the past six years, because of new methods of stocking. The basic cause was oxidation, which was made possible due to the improper dumping of coal. It was found that when coal was simply dumped on a pile, the larger pieces rolled to the bottom, forming a mat through which air could reach the center at the bottom of the pile. Oxidation would start a slow heating, which gradually increased until a combustion temperature was reached. Spontaneous combustion may be prevented by so stocking the coal that the segregation is avoided and air is prevented from reaching the interior of the pile. This is simply a matter of leveling out the pile and packing it firmly. Coal is transported from the car to the stock pile with a wheeled scraper and caterpillar tractor with blade. In the illustration accompanying this article, the tracks of the bulldozer are clearly visible in the coal pile in the foreground.

Ash removal from industrial plants, formerly a source of considerable dust nuisance, may now be done without the escape of any dust, and in many plants where the fly ash and dust emitted from the stacks would be objectionable, it is eliminated by the installation of centrifugal or electrostatic separators. The use of either type requires the installation of induced draft fans. These in turn eliminate the necessity for high stacks and breechings.

With the development of the airplane and growth of airplane travel another limitation has been placed on the height of stacks or chimneys in the vicinity of airports, in that the maximum height shall not be over a line at a five-degree angle with the horizontal with the vertex at the airport. Instances have recently occurred where it has become necessary to remove the stack and install induced draft fans to meet the requirements of the National Board of Aeronautics at Washington, D. C.

The main operating floor of boiler and compressor rooms are generally red quarry or gibraltar floors. Walls are wainscoted up to about eight feet with salt glazed blocks. Piping, pipe covering and other surfaces are finish painted to leave a smooth glossy surface—all with the intent to provide an interior which may be maintained in a neat clean condition with a minimum of effort. The psychological effect alone on an operating crew in a plant well designed and finished is sufficient to return good dividends on the added cost which may be required through better maintenance and operation than would be obtained with the same equipment poorly arranged and housed in a building designed and constructed at a minimum of expense. A plant in a neat and clean condition is, in nearly all cases, a plant being well operated.



POSTWAR POWER PLANT SHOWS PROGRESS

Two versions of a power plant for Joseph E. Seagram & Sons, Inc.

Smith, Hinchman & Grylls, Inc., Architects and Engineers

ALMOST any architect would approve the above rendering of a power plant designed for postwar construction. He would certainly vote it a functional and fresh and imaginative design, as befits a postwar plan. It represents, nonetheless, what its designers regard as a fairly conventional scheme, at least in one major respect. The rendering on the opposite page, an alternate for the same plant, is based on a more unconventional idea, developed to guard against excessive obsolescence.

The difference is a matter of supports for the building and for the heavy equipment to be housed in it. The first scheme is the conventional one of integrating building supports with equipment bases. The second provides separate supports, so that the building is entirely independent.

Smith, Hinchman & Grylls have run across cases where a perfectly sound power plant building had its economic life cut short because the steam and power generating equipment in it had become obsolete. This second scheme, then, makes it possible to replace machinery and its supports at a later date, without also removing the building.

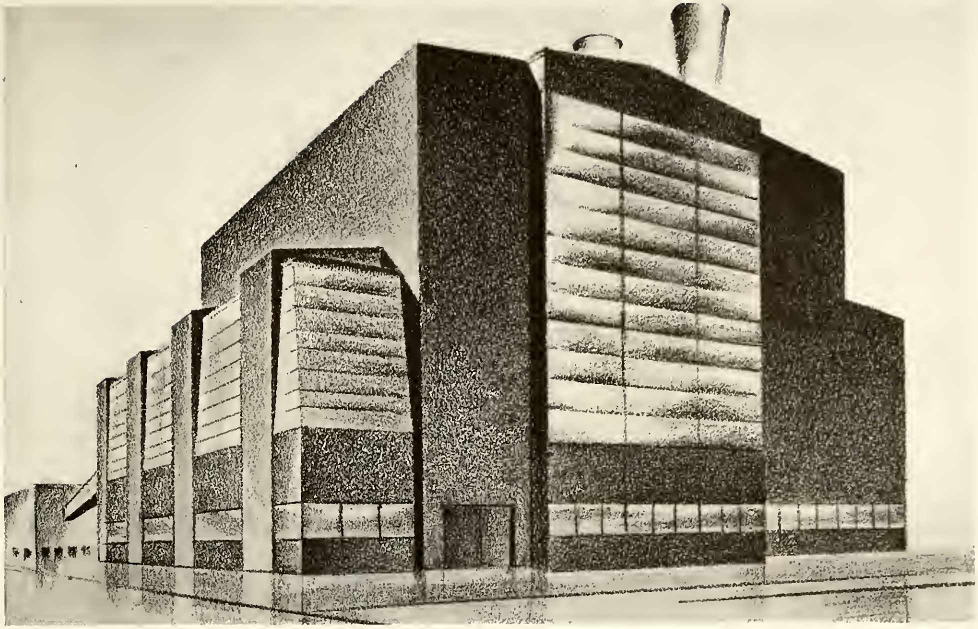
The difference is more specifically illustrated in the sections on pages 260 and 261. Figure 1 is a cross section of the plant contemplating the use of steel in the conventional "integrated" scheme. In the "unintegrated" scheme in Figure 2, designed for construction in reinforced concrete, the boilers would have their own supporting structure complete with runways, operating galleries and access stairs, entirely separate from the building framework.

Aside from this structural innovation, the design illustrates a problem frequently encountered in power plants for industrial establishments—the complications of plant process in the equipment of the power plant. This one is for a huge distillery, and suggests another innovation through the use of waste stack gases for drying by-products.

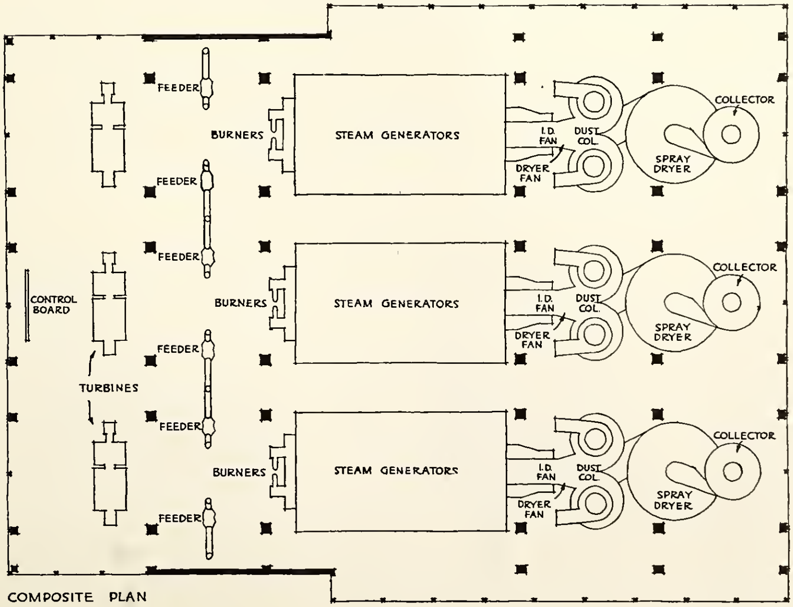
First by-product is the spent grain that is marketed to compounders of stock feed. This is the grain remaining in the "beer" as suspended matter after the alcohol has been driven off. This dealcoholized beer with its grain content as it is drawn from the bottom of the still is largely known by the inelegant but descriptive term, "slop." Incidentally, by a simple change in terminology, "slop" becomes "stillage," and can then be sold for food as well as for feed.

Other by-products are the carbon-dioxide given off in large volumes in the fermenting process which may be recovered and liquefied, or made into dry ice, and the vegetable oils obtainable from the grain by de-germing before milling or by washing the spent grain with a solvent after drying.

It is the drying operations on the stillage that are particularly recognized in the designs contemplated by the accompanying studies. Some further description of the handling of the stillage will aid in understanding them.

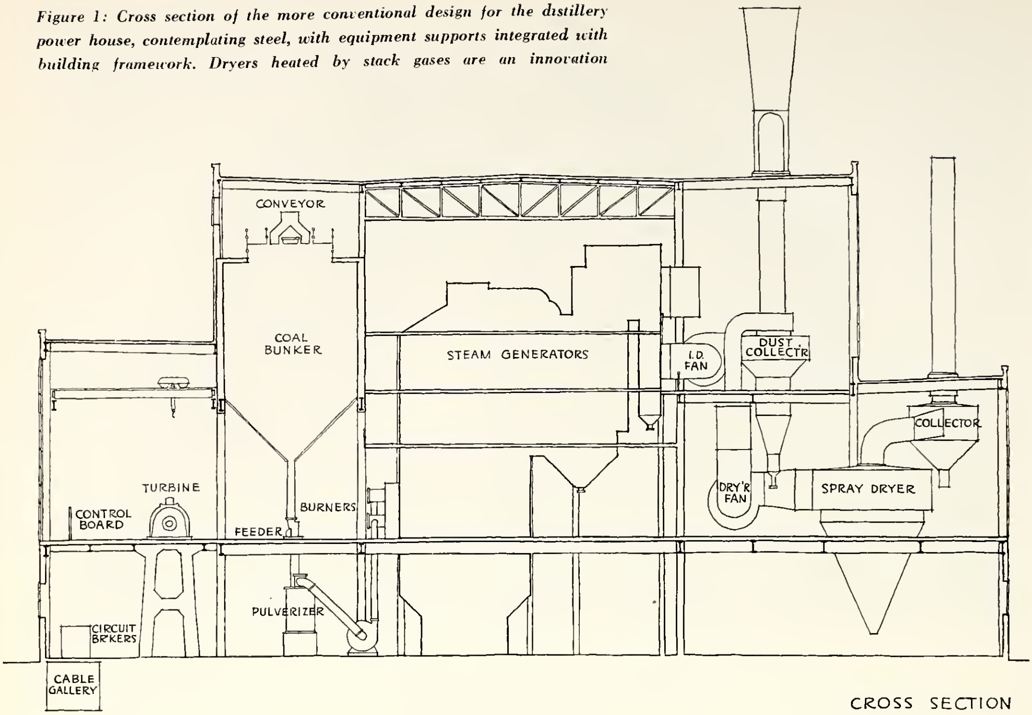


One version (rendering, opposite page) has the supports for heavy power equipment integrated with the building framework. In second version (rendering above) supports are separate, so that equipment could be replaced when obsolete



COMPOSITE PLAN

Figure 1: Cross section of the more conventional design for the distillery power house, contemplating steel, with equipment supports integrated with building framework. Dryers heated by stack gases are an innovation



It is the usual practice to strain the insoluble portion of the grain from the stillage, drying it in a conventional rotary dryer, heat being supplied by steam, waste stack gases or direct firing. The thin stillage is concentrated in multiple effect evaporators, and in many plants is mixed with the spent grain and dried with it. More advanced practice provides for drying this concentrated stillage, generally termed syrup, separately. The drying of the syrup may be accomplished on a steam heated rotary drum dryer similar to that used for producing powdered milk, or in a spray dryer. It is this method of drying that is contemplated by the preliminary designs accompanying this article

From the diagram in Fig. 3 it may be noted that the pressures at which the steam is required for processing operations is within such ranges that the greater part of this steam can be supplied as exhaust, or extracted, from the turbine generating units supplying the plant's electric power. These requirements usually considerably exceed the amount of exhaust steam that becomes available if the generating of electric power is limited to that used by the distillery itself. From this standpoint the engineers have found from their heat balance studies that steam generat-

FIGURE 3

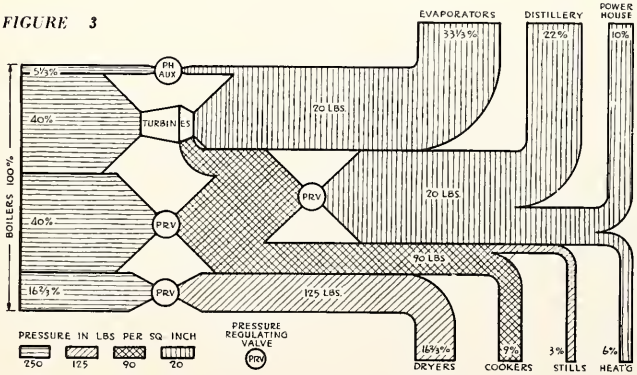
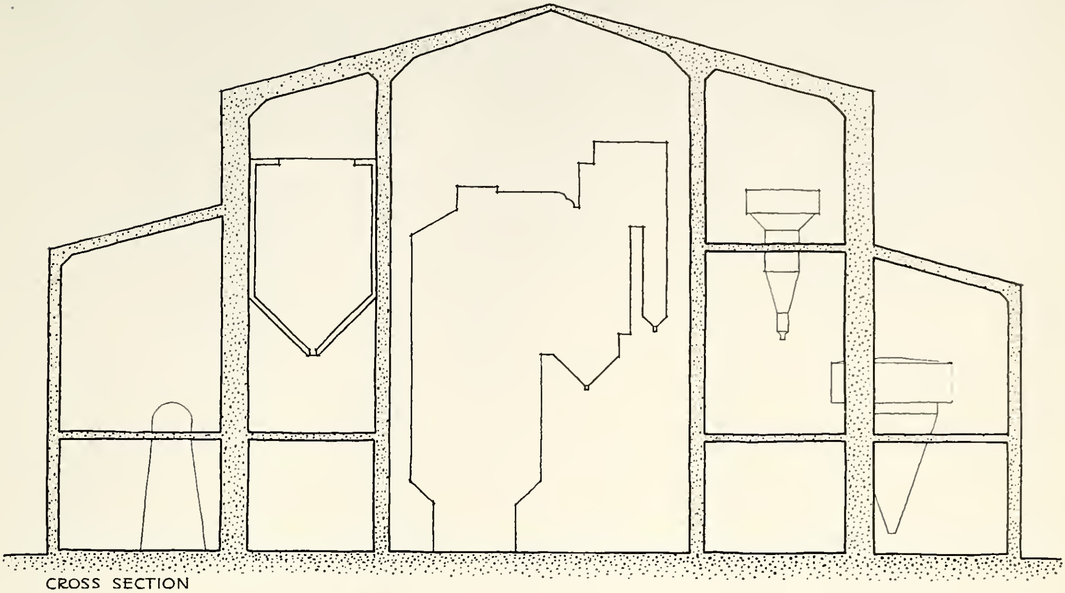


Figure 3: Steam utilization at a distillery. Exhaust, or extracted, steam is used for plant processes

Figure 4: Chart of electric power utilization in a distillery. By-products consume most of the power

Figure 5: How electric power and steam consumption (per gallon of whiskey) vary with plant operations

Figure 2: Building framework, here shown in reinforced concrete, is independent of supports for boilers and turbines, which normally have a shorter economic life than buildings. This scheme permits equipment to be replaced



ing units of high pressure are not called for in meeting the design conditions of the moment. It is their experience, however, that development and improvement with the processes and operations in a progressively operated industrial plant, and especially in the distillery field, call for more and more things to be done electrically. It is their judgment that the selection of steam generating equipment, whose pressure and temperature characteristics will enable electric power to be generated more efficiently than the heat balance requirements initially indicate, is well warranted in establishing the design of the plant. Thus improved efficiency generation later provides extra capacity for electricity.

The design contemplated by both of these cross-sections is basically the same particularly in combining with them the drying of the syrup utilizing spray type dryers operated by the stack gases from the boilers. The engineers do not represent that the engineering has been carried to a point where this arrangement for supplying heat to the spray dryers can unqualifiedly be adopted over other possible methods, but studies indicate the possibilities, and the opportunity for economy is readily recognized.

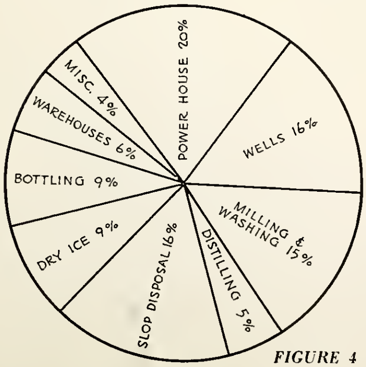
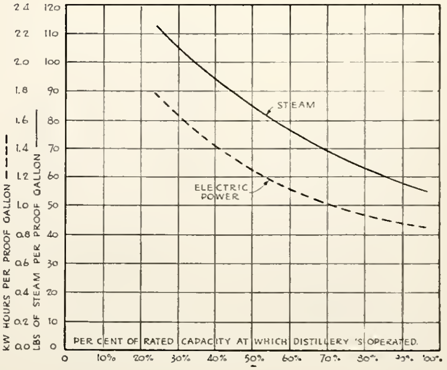
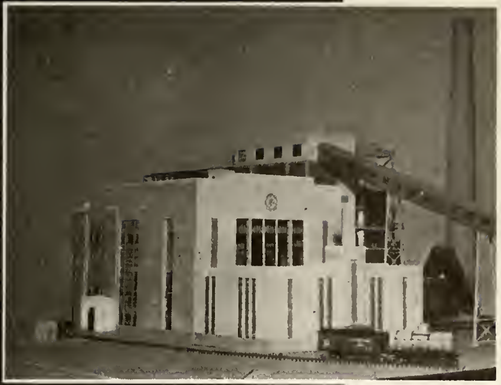
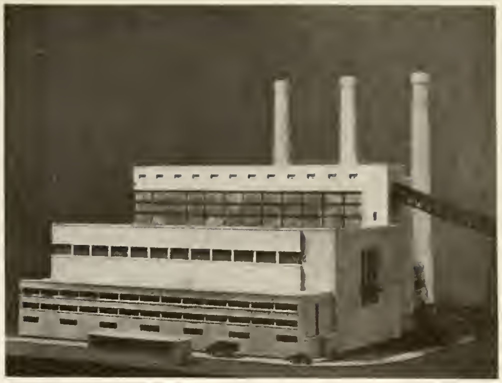


FIGURE 4

FIGURE 5







Richard Garrison Photo

POWER PLANT PROGRESS

Sewaren Generating Station

Public Service Electric & Gas Company,

Owners and Engineers

Walker & Poor, Consulting Architects

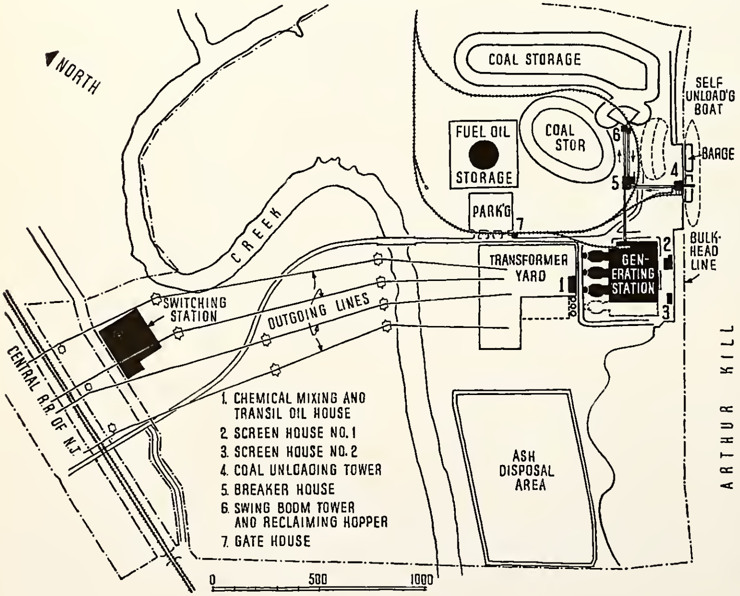
United Engineers & Constructors, Inc., Builders

A FAVORITE modern theme, the natural compatibility of contemporary architecture and basic engineering, here finds expression in an enormous electric generating plant. A power plant, with its great boilers, stacks, and turbine room has good elements for visual interest, but older precedent seems to dictate that they be housed in Greek temples. When architecture begins to use those elements, instead of covering them, the result becomes something to express the pride of the engineers as well as the architects.

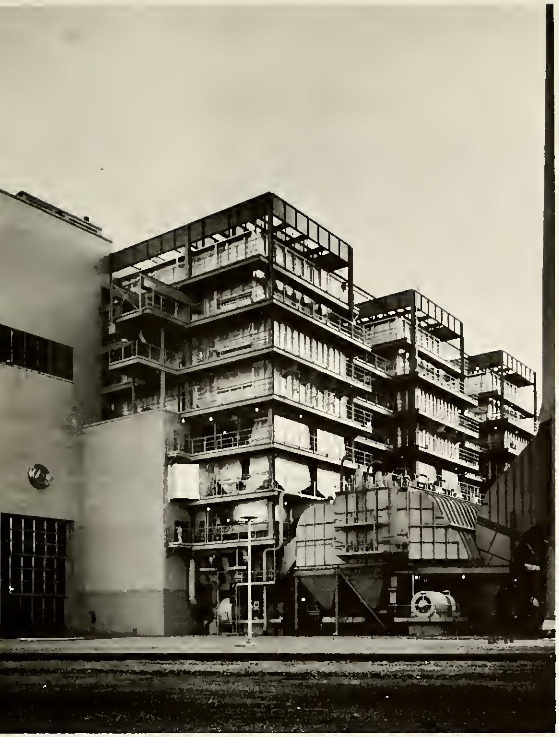
In this case the power plant engineering was done in advance (model picture above left). The architect's assignment was "the orderly disposition of the main elements . . . and to clothe the whole complex fabric in a new simple, functional building" (model right above).

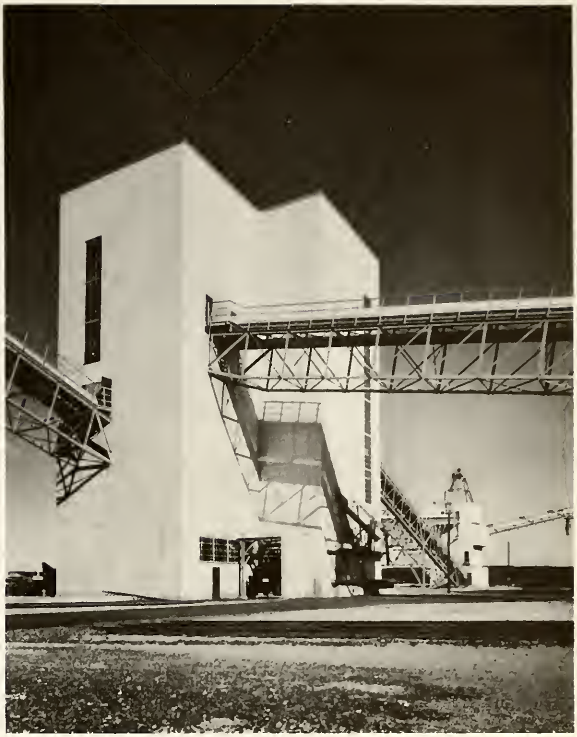
The elements were arranged in a series of steps with the lowest, the three-story service building, nearest to and parallel with the water, turbine room next, then the highest portion, the coal bunker and boiler house. The rear side has the stacks, 225 ft high, for accents (the architects introduced entasis as well as taper).

It would have been possible, of course, to continue the building at the rear to enclose the boilers completely. But why build a nine-story building for boilers, and then have to ventilate it against boiler heat, when nature will do it for you?

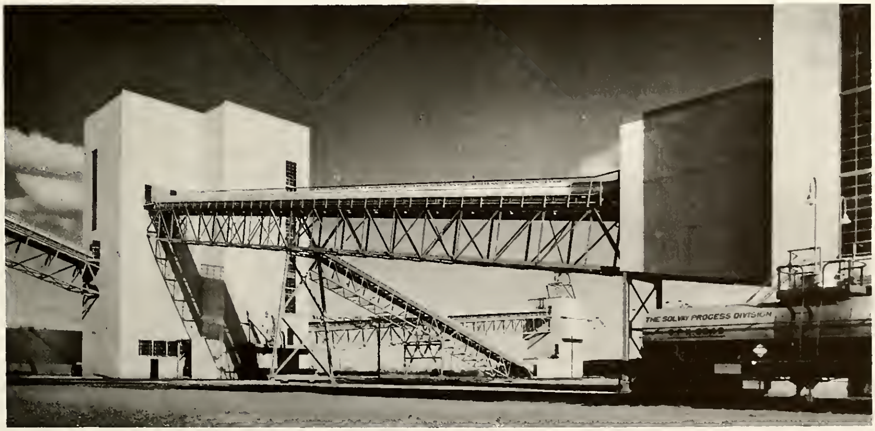


Site for Sewaren Station was 150 acres of salt marsh bordering on Arthur Kill. 55 acres were filled for the station with sand and gravel dredged from the kill. Buildings and machinery are supported on wood pile foundations covered with a concrete mat. The kill provides water transportation for coal and oil, also supplies cooling water for the condensers. At present the station has three 110,000 kw turbine generators; a fourth of 125,000 kw capacity will be added next year. Boilers operate at 1500 psi, 1050 F



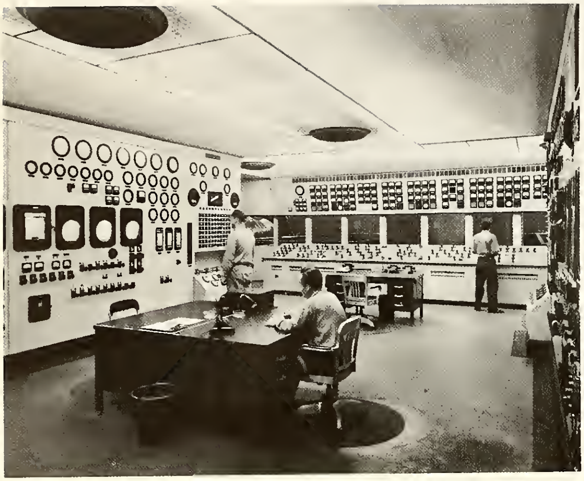


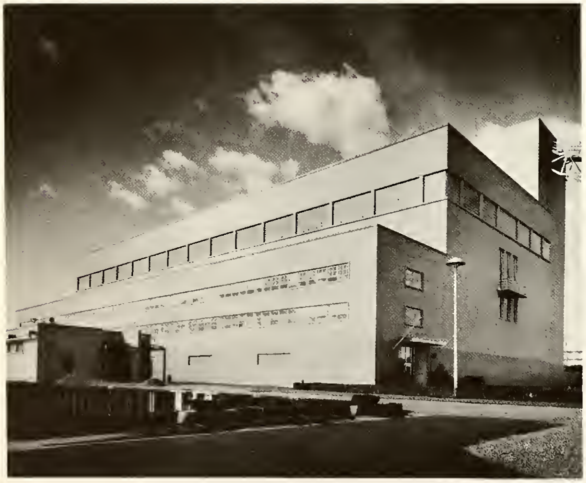
Richard Garrison Photos

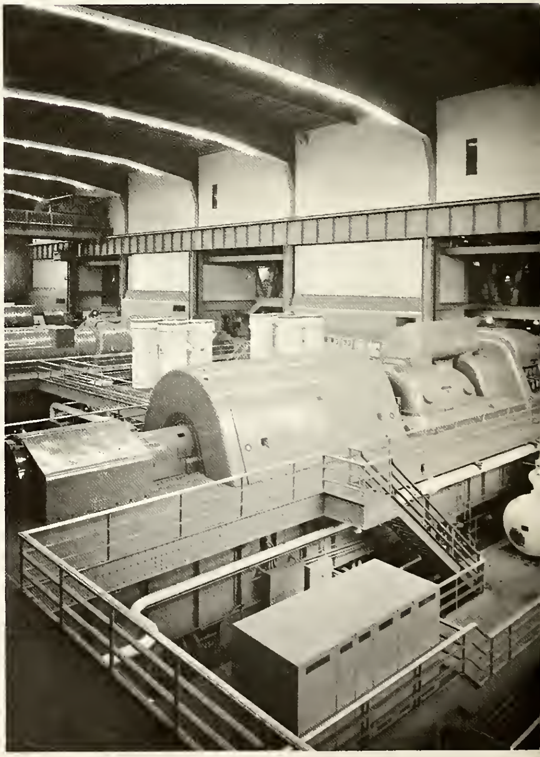


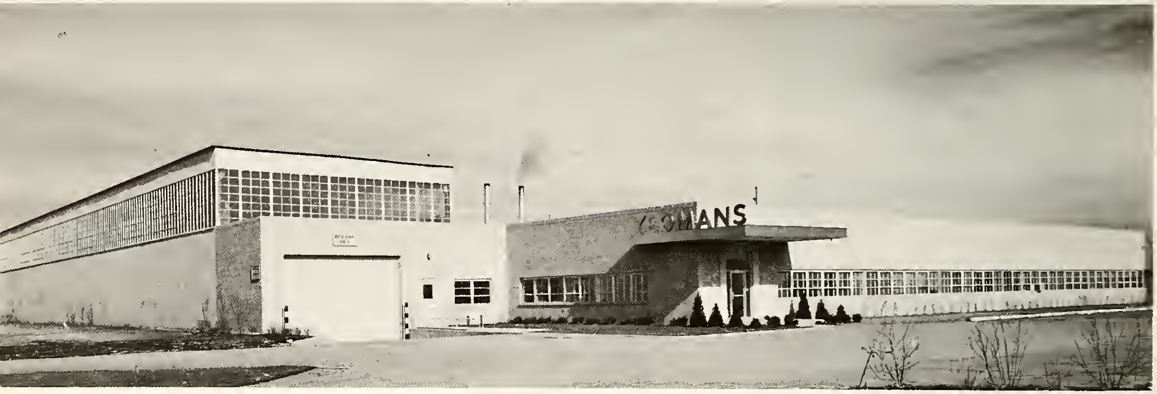
Where outside light was needed it is provided by continuous rows of glass block in the turbine room and continuous sash in the service building. Otherwise the composition uses large unbroken masonry walls. Main building is gray brick, with limestone window surrounds and copings. As low maintenance cost was a factor in design, all sash are aluminum; the large windows in the turbine room, main entrance doors and the large triple-lift door are stainless steel. For ease in cleaning, interior walls in boiler house are 5 by 12 salt glazed tile, in turbine room 8 and 16 gray ceramic tile. Coal handling structures are steel frames covered with flat Transite. Conveyor belts on bridges are sheltered by stainless steel hoods

Richard Garrison Photos









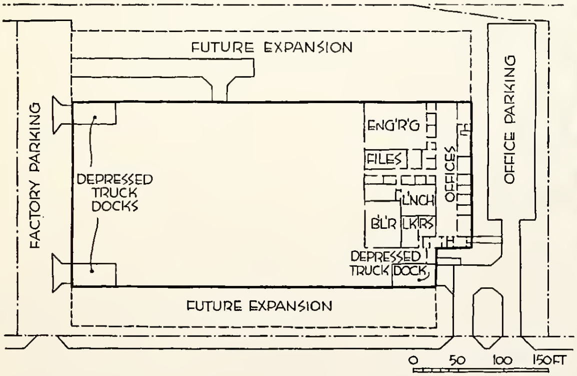
TYPICAL FACTORY BUILDING AT CLEARING

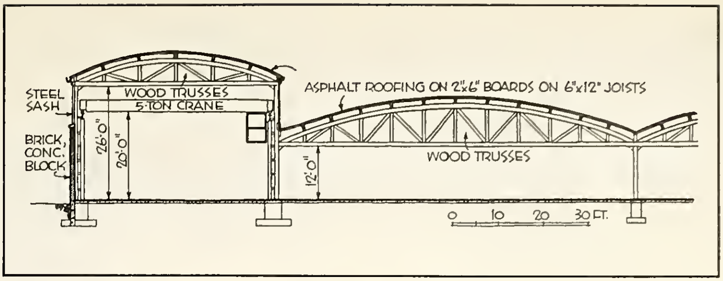
This is one of the typical small plants in the Clearing Industrial District, Chicago, an industrial subdivision built around good rail and truck transportation, with scores of small factory buildings all generally economical, clean and functionally designed. This one has wide column spacing — 80 ft — except in the one high bay for crane operation, where the span is 44 ft, with clear ceiling height of 26 ft. The building is planned for expansion in two directions: an additional crane bay to the west, one additional 80-ft bay to reach a future track to the east. Wood trusses were used because this building was constructed at a time when steel was in short supply. The building depends now on trucking for its transportation needs, but a rail siding can be brought in at any time it is required.

Assembly Building for Yeoman Brothers Company

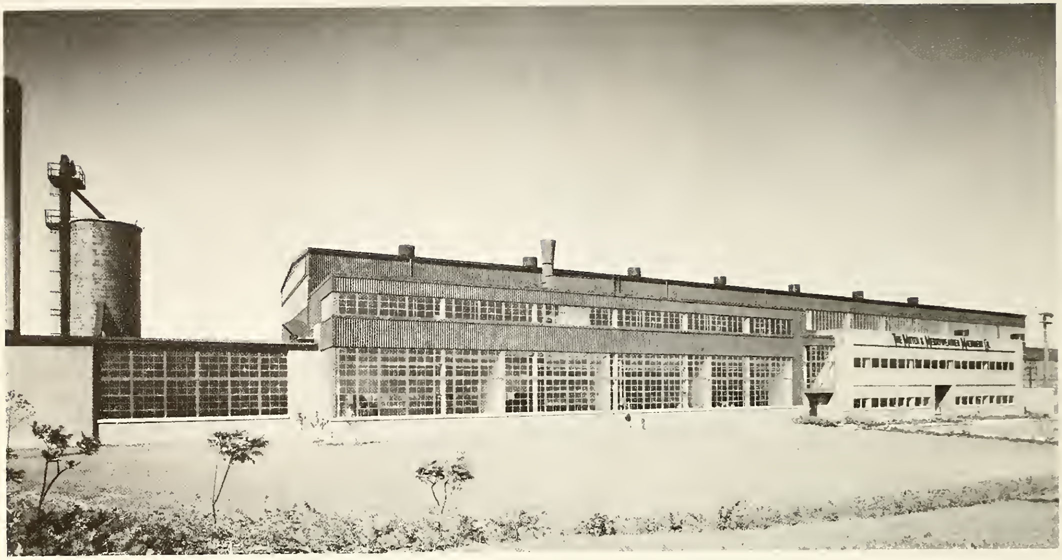
Clearing Industrial District, Chicago

John S. Cromelin, Architect



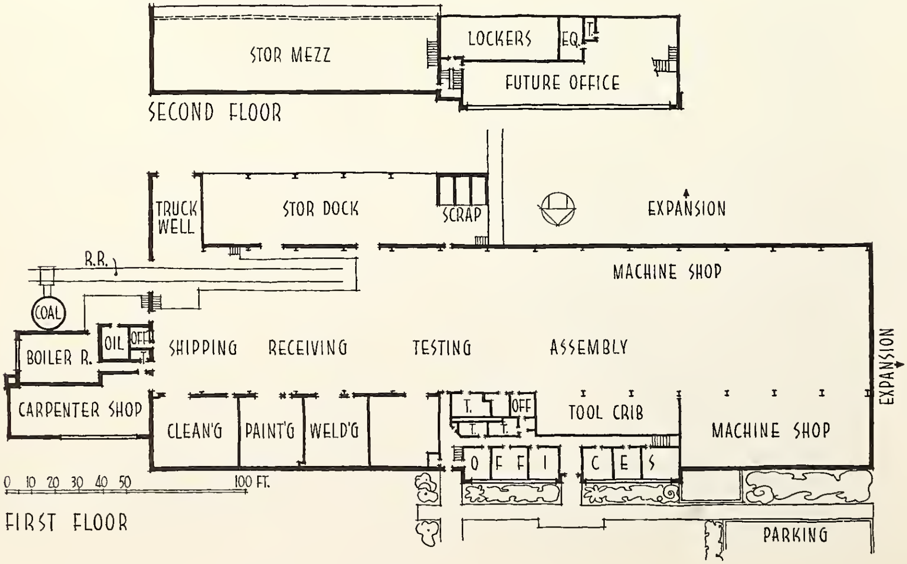


Hedrich-Blessing



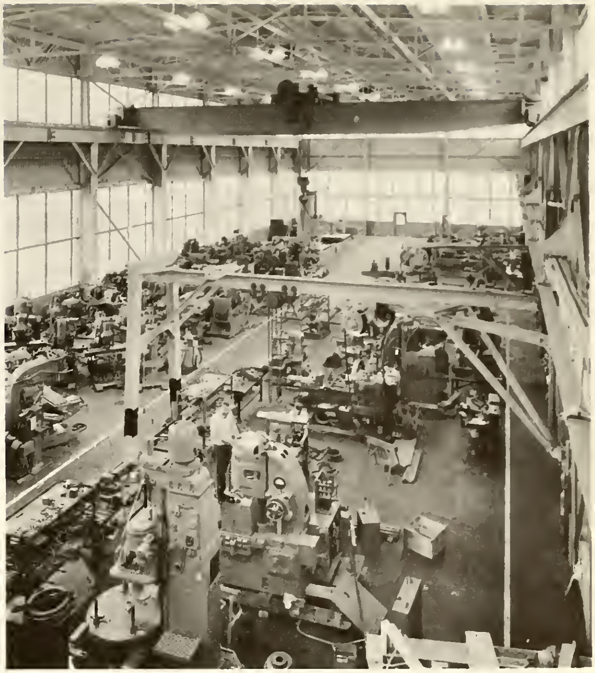
SERVICE BUILDING FOR MACHINE TOOLS

Reconditioning Plant for The Motch and Merryweather Machinery Co., Euclid, Ohio



Garfield, Harris, Robinson & Schafer

Architects

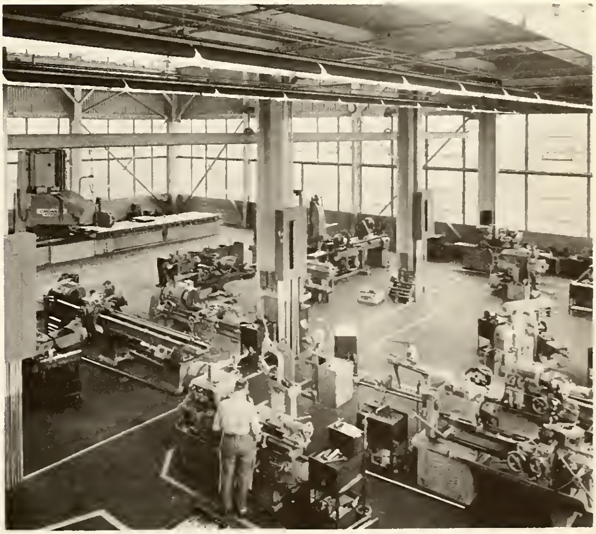


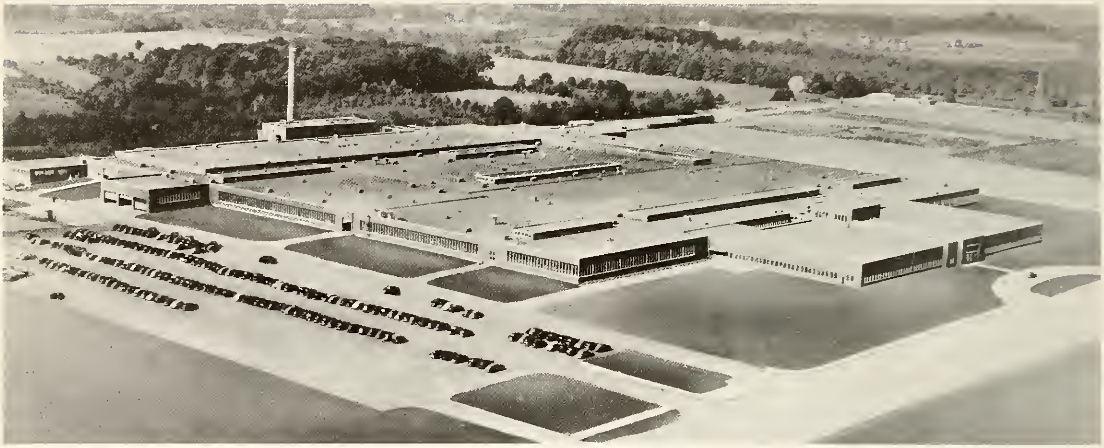
Special problem here was handling equipment, because of variety of loads and operations. A 25-ton overhead crane travels and services the building's entire 300-ft length; four power reel-type jib cranes aid the running-in of machines and small assembly work; and gantry cranes, traveling the full length of the building, interlock with overhead cranes

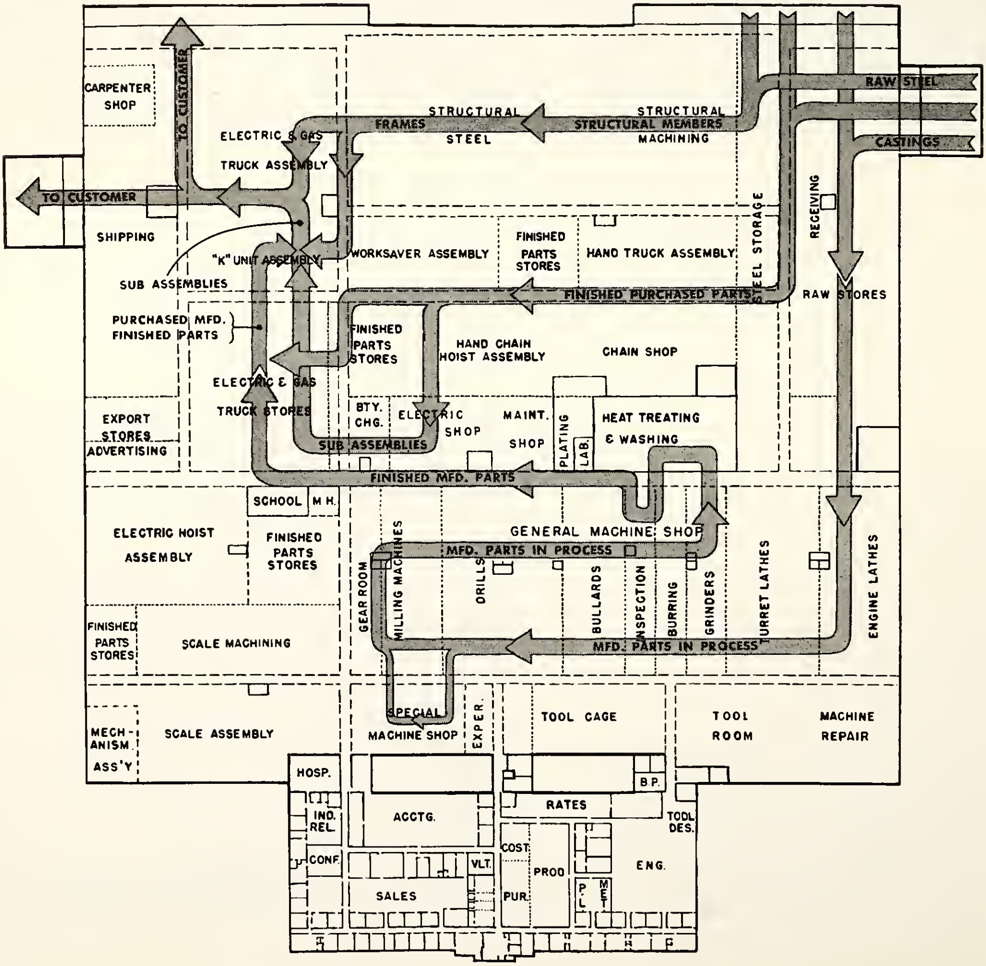
THIS IS a wartime building in both purpose and planning. It is really a service garage for large machine tools, where these war-important machines are repaired, rebuilt and resold. It represents the salvage operations of a machine-tool manufacturer, these operations grown to such proportions as to warrant a separate plant.

The building also represents wartime operation in certain phases of design, for it was built when steel shapes were tight, as well as construction labor. It did manage to achieve a steel frame, but one designed for available steel rather than for logic of choice. Also it uses masonry only for the bottom of the wall where it is really necessary; above a base course the wall is all windows with spandrel sections of an asbestos material.

Guiding design principle was open, well lighted space, for here a great variety of machinery must be handled, rather than some simple line operation.






TO CUSTOMER
CARPENTER SHOP
ELECTRIC & GAS
TRUCK ASSEMBLY
TO CUSTOMER
SHIPPING
FRAMES
STRUCTURAL STEEL
STRUCTURAL MEMBERS
STRUCTURAL MACHINING
RAW STEEL
CASTINGS
"K" UNIT ASSEMBLY
WORKSAVER ASSEMBLY
FINISHED PARTS STORES
HAND TRUCK ASSEMBLY
STEEL STORAGE
RECEIVING
RAW STORES
SUB ASSEMBLIES
FINISHED PURCHASED PARTS
PURCHASED MFD. FINISHED PARTS
FINISHED PARTS STORES
HAND CHAIN HOIST ASSEMBLY
CHAIN SHOP
ELECTRIC & GAS
TRUCK STORES
EXPORT STORES
ADVERTISING
BTY. CHG.
ELECTRIC SHOP
MAINT. SHOP
PLATING
LAB.
HEAT TREATING & WASHING
SUB ASSEMBLIES
FINISHED MFD. PARTS
SCHOOL
M.H.
ELECTRIC HOIST ASSEMBLY
FINISHED PARTS STORES
GENERAL MACHINE SHOP
MFD. PARTS IN PROCESS
GEAR ROOM
MILLING MACHINES
DRILLS
BULLARDS
INSPECTION
BURRING
GRINDERS
TURRET LATHES
ENGINE LATHES
FINISHED PARTS STORES
SCALE MACHINING
MFD. PARTS IN PROCESS
MECHANISM ASS'Y
SCALE ASSEMBLY
SPECIAL MACHINE SHOP
EXPER.
TOOL CAGE
TOOL ROOM
MACHINE REPAIR
HOSP.
IND. REL.
CONF.
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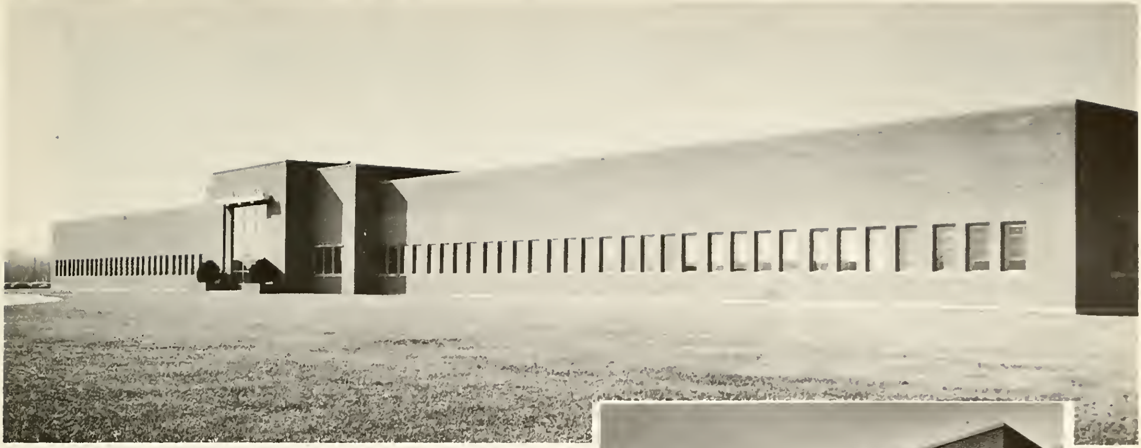


Joseph W. Molitor

The Ballinger Company

Architects and Engineers

PLANT FOR MATERIALS HANDLING MACHINERY

Materials Handling Plant for Yale & Towne Manufacturing Company, Philadelphia

IN THE MODERN FACTORY materials handling machinery and its proper use are just about the whole story, largely setting the pattern for the production line and thus for the building itself. This new plant is the direct result of materials handling problems in a company manufacturing materials handling equipment. Its own facilities and assembly lines were getting out of date, so a completely new plant became necessary.

Naturally, then, the handling of parts was the basis of design, and, as the diagram on the opposite page clearly shows, the complications of making a wide variety of equipment are reflected in the layouts. The architects, working with Yale & Towne production engineers, formulated these basic requirements:

1. Adequate facilities to receive, check and distribute incoming material.
2. Short, direct routes to and from raw stores areas and processing areas to provide storage and efficient movement of materials.
3. Arrangement of machinery and equipment to provide ample room to place materials within easy reach of workers.
4. Access to machines and benches for quick delivery of materials, and for fast pick-up of outbound materials and waste.
5. Grouping of machines and departments so that movements between operations would be as short as possible.
6. Sufficient storage facilities in process between operations.
7. Stock rooms and tool cages located to reduce handling to a minimum.
8. Facilities to pack or crate and ship by all classes of carriers.

It was therefore necessary to lay out each department by an analysis of the flow of materials through each operation, and then to lay out each machine and piece of equipment. When the complete flow line of each

Joseph W. Molitor

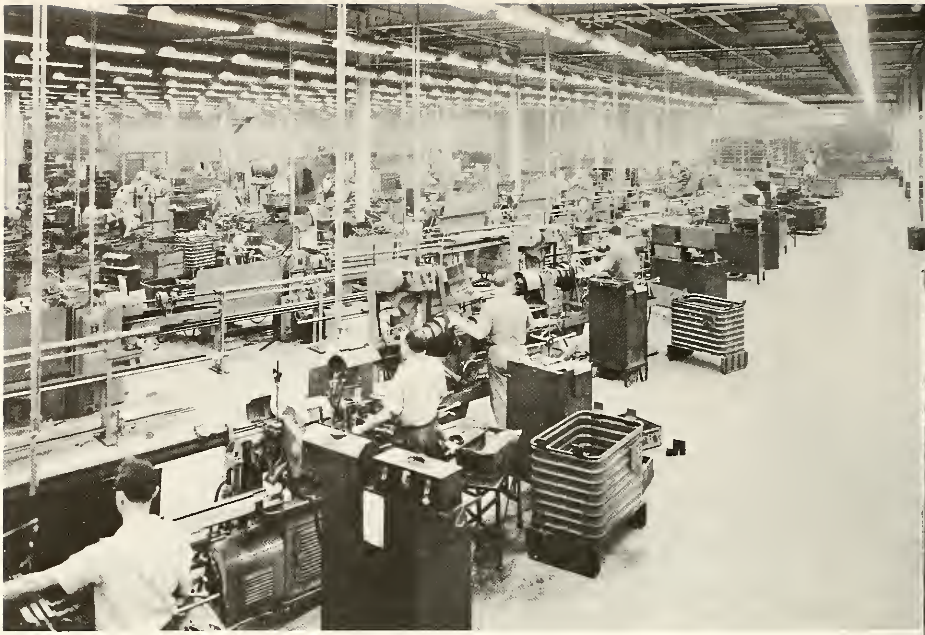
Main entrance lobby, above, is done with the same simplicity that characterizes the exterior. It opens into a products display room (center photo). Office areas and drafting rooms are kept just as open and flexible as the production areas

department and space requirements were determined, the general shape of the building was established. Flexibility of occupancy was an important consideration throughout.

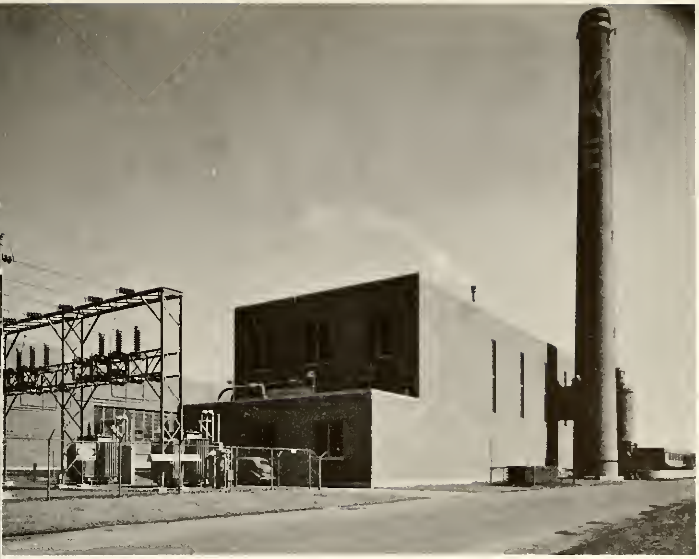
The plant contains about 750,000 sq ft on one floor, and is located on a 93-acre plot on the northeast edge of Philadelphia. The manufacturing areas are not cut up by walls or barriers except for storage areas or tool rooms, and these are generally separated by removable wire mesh partitions. Where required a few areas are partitioned to confine or exclude dust, noise or heat. Thus the production lines are free to change with a minimum of difficulty.

Lockers and toilet rooms are located on mezzanine floors, located conveniently to production lines, with small auxiliary toilets at the base of each mezzanine. Most of the plant has a clearance of 18 ft below the girders; certain smaller bays are 24 ft in the clear.

Some careful computations by the sanitary engineers in the architect's office resulted in a saving of $100,000 in the roof drainage system. Briefly, most code requirements are based on run-off from pitched roofs, but a flat roof does not discharge water nearly as fast. Thus for a certain assumed intensity of story, the run-off time is higher, and the storm drain pipe sizes can be reduced accordingly.



YALE

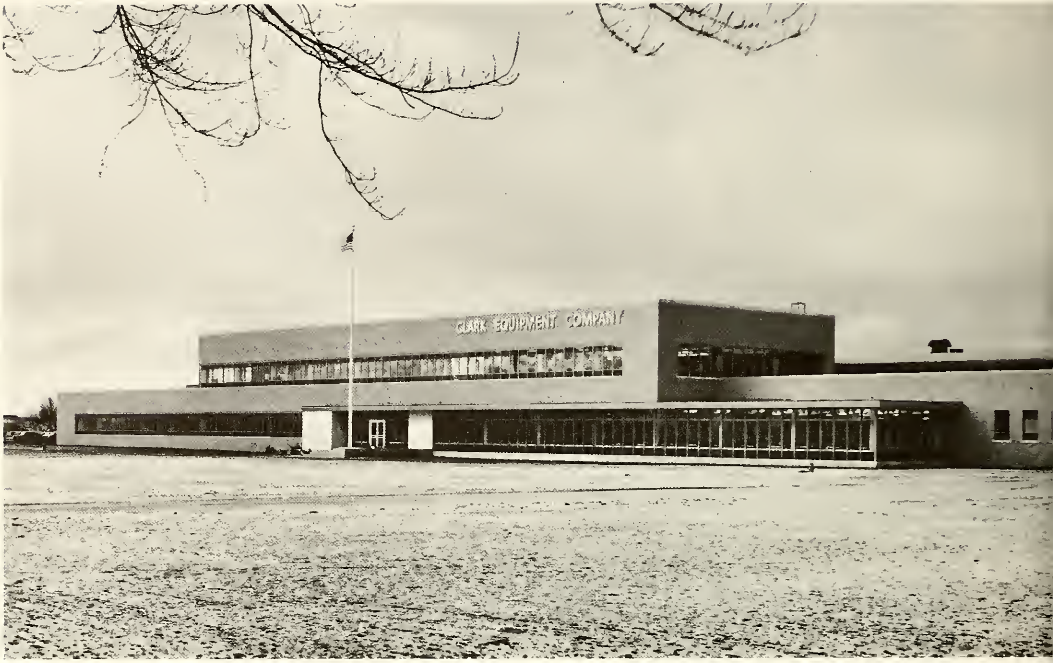


Left, above: careful positioning of machine tools shortens handling routes. Left, below: end of the production line for motorized handling trucks. Separate boiler house (at top, right) now contains three boilers, two of 35,000 lb per hour capacity for winter use, one of 14,000 lb for lighter summer loads. Plant is heated by ceiling mounted unit heaters, arranged also for use as ventilators

Joseph W. Molitor

FACTORY FOR CLARK EQUIPMENT COMPANY

Albert Kahn Associated Architects and Engineers



Al Salter Photos

JACKSON, MICHIGAN

Two-story office building is attached to front of factory building. One-story projection in foreground, with full glass walls, is employees' cafeteria of 7000 sq ft area

As America goes on expanding its already fantastic productive capacity, new factories seem to go up so fast that it all seems remarkably easy, and one plant seems much like another. On closer inspection, however, it begins to appear that each new crop shows improved design, closer design integration, in a gradual process of refinement. In other words, factories go through the same evolution as the improving products of the factories.

From the standpoint of appearance, the refinement process appears entirely natural. It is pretty generally true that factories have taken on a directness of expression that seems to fit in forthright fashion, without disguise but with a new feeling of dignity and purpose. If it all looks easy, it might be considered that virtue always looks simpler to achieve than it is.

Inside the plant the same process of development has gone forward, but perhaps with less lyrical attention to expression and more to function. Here factory design gives more attention to welfare and comfort and efficiency of workers, to effectiveness of layout and materials handling, to facilities for power and light and transportation.

This new plant for the Clark Equipment Company is fully representative of the modern factory in all respects, and warrants a fairly detailed description of its interior facilities.

The plant is located on a large tract of land southeast of Jackson, Michigan, along the Michigan Central Railroad, and is expected eventually to provide employment for 3000 workers. The project consists of (1) a one-story manufacturing building; (2) a two-story office building connected to the east end of the manufacturing building; (3) the boiler house at the rear of the plant, and (4) plant service facilities including substation, water tower, pump house and tank farm. The employees' parking lot is located along the south side of the plant.

The manufacturing building is 815 ft long and 522 ft wide, covering a floor area of 425,125 sq ft. The column spacing in this area is 40 ft by 60 ft, and the clear height under the bottom chord of the steel trusses is 16 ft. The frame is of steel; the enclosing walls are of brick and steel sash, and the roof is cement tile with 1½ in. of insulation and built-up roofing.

The office building has a floor area of 42,600 sq ft including first and second floors, and is located 225 ft back from the roadway, allowing for a deep lawn and landscaping. The first floor of this building houses the general offices, process engineering and plant layout, accounting, the personnel office, hospital, cafeteria and kitchen. The second floor contains the executive offices, sales and general offices, product engineering, purchasing and production control, and conference rooms.

At present the 7000 sq ft dining area of the cafeteria provides seating capacity for approximately 600 persons at one time and is equipped with two counters, both used for serving. Provision is made for the installation of an additional cafeteria counter if and when it is re-

Hydraulic leveling devices at truck dock

Employees' cafeteria

quired to meet the needs of an expanded labor force.

The frame of the office building is of concrete construction, and the exterior walls are brick and stone. Inside walls in the office area are of tile and plaster; in the cafeteria, kitchen, hospital, toilets and locker rooms the walls are of glazed hollow tile. The floor of the building is of cement, monolithically finished. The finish floor generally is asphalt tile; in the hospital area, cafeteria and toilet rooms the floor is terrazzo, and in the kitchen quarry tile. The ceiling throughout is acoustic tile suspended from the concrete floor slab. The interior partitions are of metal and glass.

The entrance lobby of the office building has glazed tile wainscoting with photo murals above extending to the ceiling line on two sides. The exterior wall and entrance vestibule are of aluminum frame with large plate glass panels.

The walls of the office generally are painted a light gray-green with the sash and doors in a slightly darker tone and black base. The window stools are dark cedar Tennessee marble. The ceilings are slightly off-white; and the asphalt tile floor is marblelite, dark brown in color.

Walls and columns in the factory area of the manufacturing building are painted with a dado 6 ft high of dark green, and a very light green above, including all exposed steel surfaces.

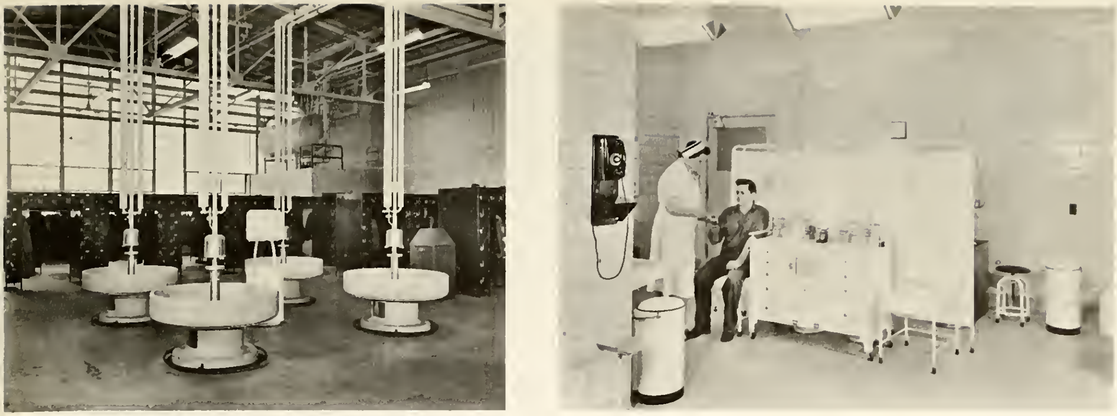
The employees' entrance is located at the south side of the factory building easily accessible from the parking lot. The locker and washrooms are located at both sides of the entrance corridor; shower rooms and toilets are also provided in this area. Four raised toilets, conveniently located, have been installed in the manufacturing building.

For receiving of materials and the shipping of the finished products by truck, three truck wells have been provided and a railroad dock located at the northwest corner of the building. Hydraulic leveling sections in the dock at the truck wells are provided to compensate for differences in level between the floors of trucks and the dock. The truck wells are completely enclosed, eliminating drafts from open doors in cold weather. Since most of the materials are transported by truck, ample concrete roads have been built along the south and west sides of the plant.

All sanitary sewage runs to a central pumping station where it passes through communitors (rotating screens) before it is allowed to flow into the pumps, whence it is discharged into a force main approximately 9500 ft long. This main discharges into the sanitary system of the city of Jackson.

For the air conditioning system for the office building, three supply systems have been provided in the fan room on the second floor, between the office and factory areas. Each supply unit is equipped for filtering both the outdoor and recirculated air, and tempering the air to provide satisfactory conditions throughout the office building. This is accomplished by zoning the exterior base for supplying temperatures in these exterior bays different from those supplied in the interior areas. The air is introduced into the rooms through ceiling outlets, and the air is exhausted at both the ceiling and at the floor. Provision has been made in the supply units for the future installation of cooling coils, eliminator plates and drip pans for air cooling.

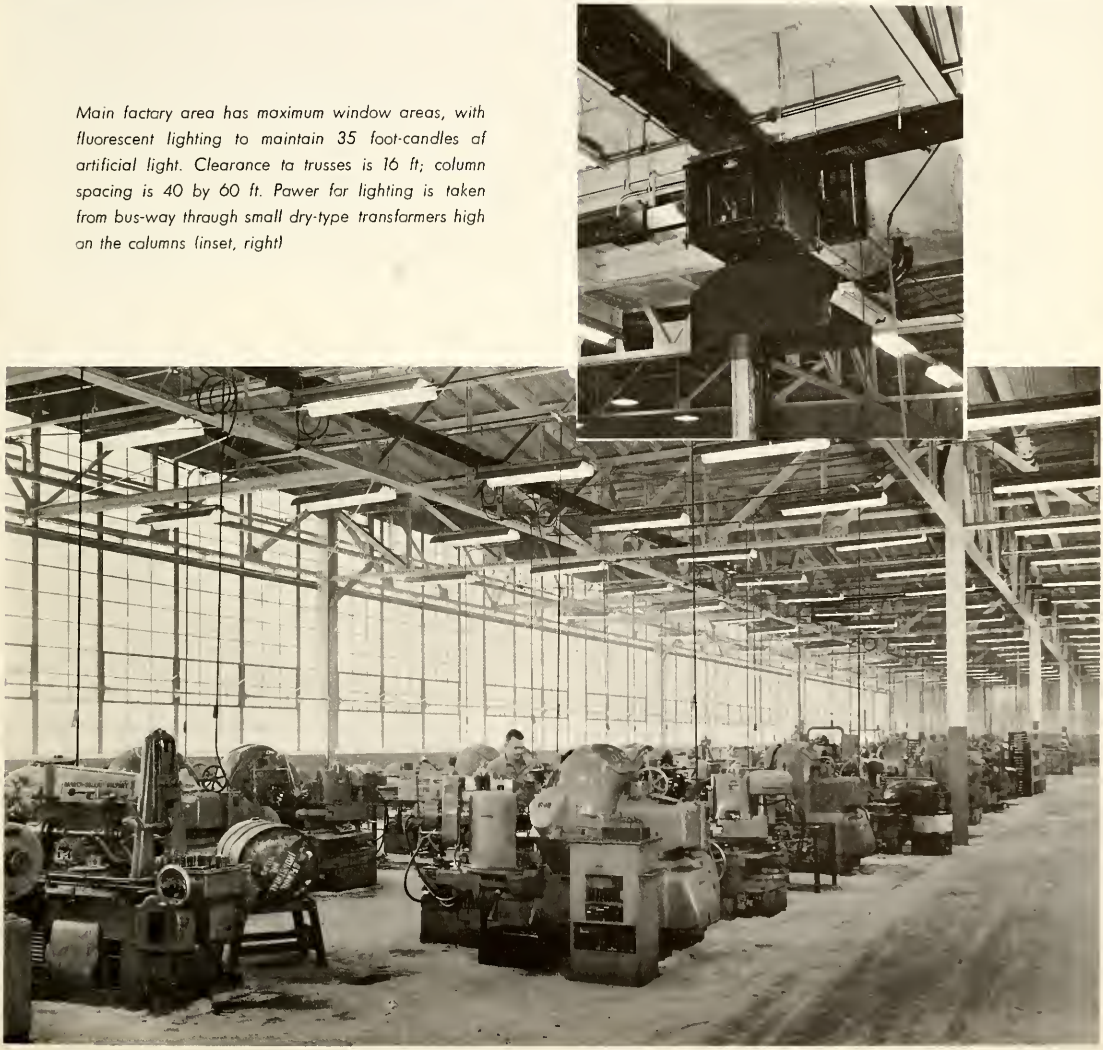
Excellent lighting was insisted upon, with fluorescent lighting of 35 foot-candles intensity maintained in the factory, with the exception of the heat treat departments in which Mercury fixtures are used, giving 16 foot-candles intensity. Office lighting is fluorescent with intensities from 40 to 45 foot-candles. The engineering department, naturally, has the greatest light intensity, 80 foot-candles of non-glare or low brightness lighting, accomplished with surface type fluorescent fixtures specially shielded in continuous rows spaced 6 ft on centers.

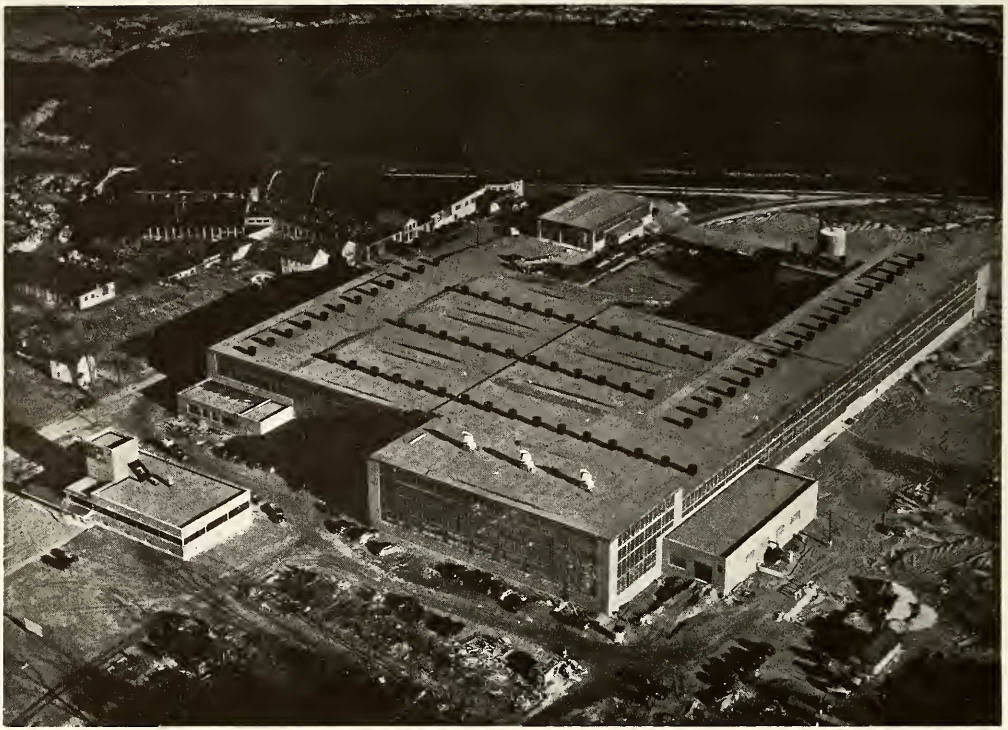


Employees' washrooms and medical station (right)

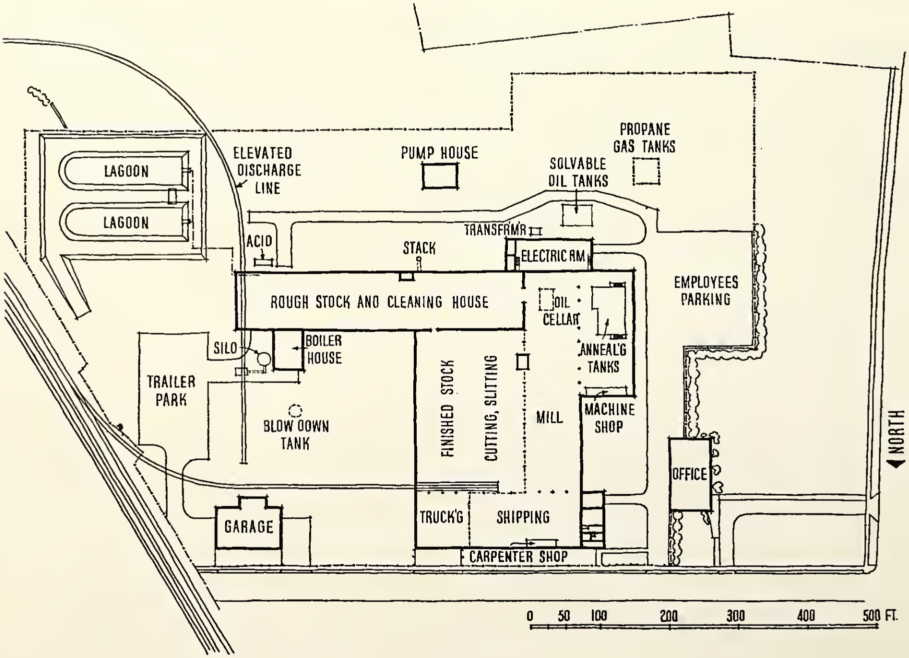
Al Salter Photos

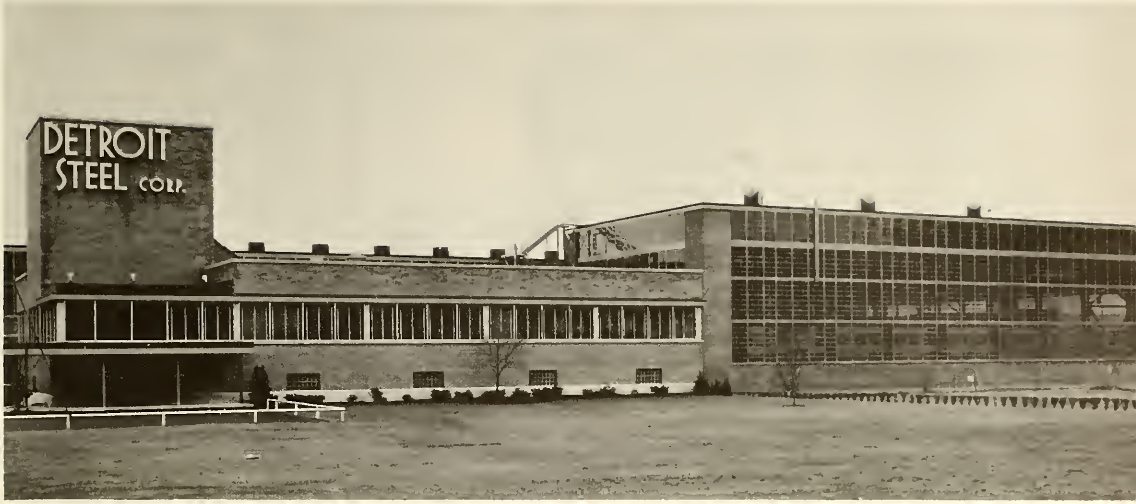
Main factory area has maximum window areas, with fluorescent lighting to maintain 35 foot-candles of artificial light. Clearance to trusses is 16 ft; column spacing is 40 by 60 ft. Power for lighting is taken from bus-way through small dry-type transformers high on the columns (inset, right)





Aero-View by Irving V. Tier





FINISHING PLANT FOR DETROIT STEEL CORP.

Strip Mill and Distribution Center, Hamden, Conn.

Leo F. Caproni & Associates, Architects and Engineers

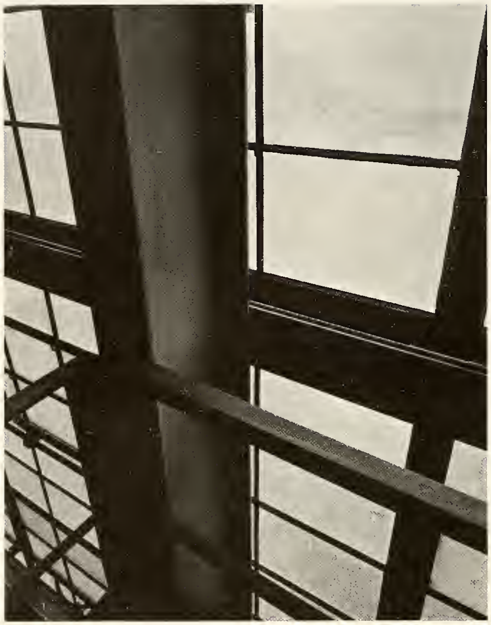
Joseph W. Molitor Photos

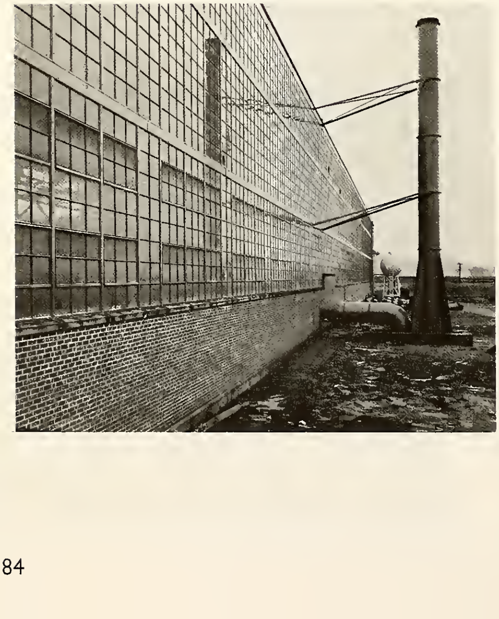
WHILE the processes in a cold roll strip mill might not seem especially conducive to architectural esthetics, this plant exemplifies the now-familiar observation that modern architecture achieves its most unquestioned success in industrial buildings. Here elements like great crane bays, continuous picklers, temper mills, huge areas of fenestration, seem to assert themselves on the architect's board. Perhaps the design is not as easy as it thus sounds, but at least such strong elements leave little room for confusion as to the meaning of "function" in design.

Functionalism in this plant is of a high order, both technically and economically. The project was conceived in economic reasoning quite typical of these times, pointing up need for a plant for secondary processing combined with warehouse and shipping facilities to serve a certain market. The architect persuaded his clients that Hamden was the logical location, then studied with them the processes involved, until the new plant now represents a high standard of efficiency.

Thus from its reason-for-being, through the study of processes in search of new savings, and on to its final appearance, this plant is a typical example of the kind of industrial expansion which may be more and more expected in years to come.

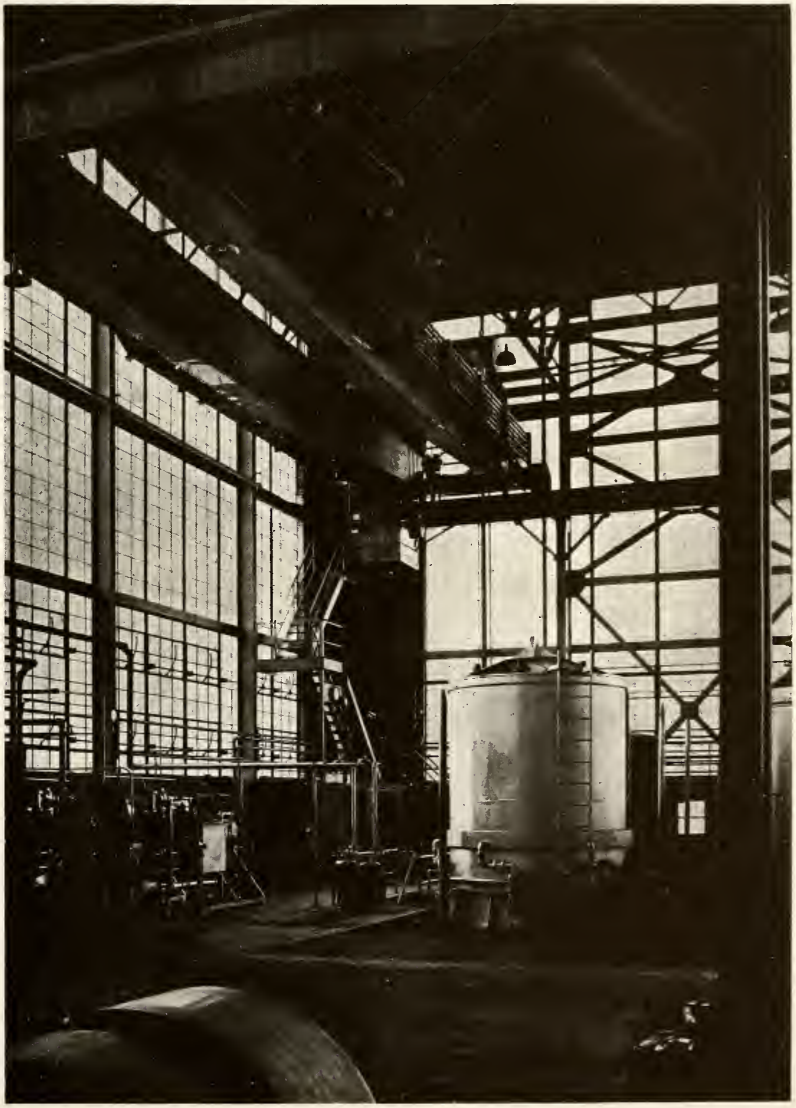
Joseph W. Molitor Photos

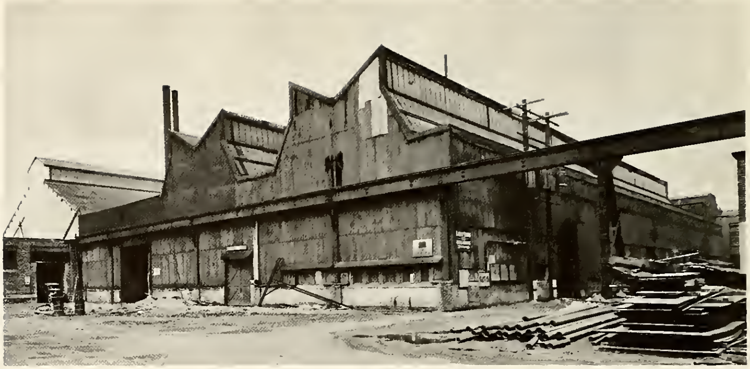


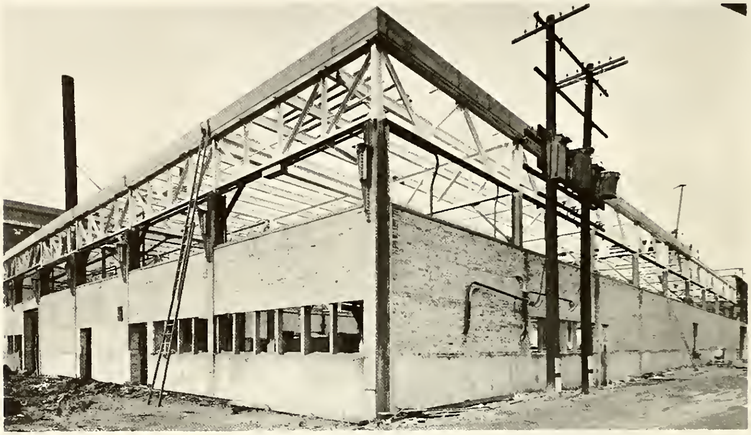


Leo F. Caproni Photos

Main plant building takes its design from requirements for heavy crane capacity, up to 20 tons, and for freedom of crane movement. Spans here are 80 ft without columns. Building is 50 ft high, again to allow for crane movement, also for light and ventilation. High steel sash are set outside of columns to give continuous fenestration. Building is designed on module system for expansion in any direction







FIRST-WORLD-WAR PLANT REMODELED

Alterations to Sun Steel Company Shop Building, Chicago

Walter H. Sobel and J. Steward Stein, Architects and Engineers

Originally a war baby, this plant was abandoned between conflicts and subsequently remodeled for Korean war-time production. Oddly enough, it was built by the government for the First World War, not the Second, and now finds new usefulness in the current expansion of steel fabrication industries.

Unoccupied for many years, the building suffered considerable deterioration. Without heating and proper maintenance all of the wood construction decayed and rotted. Surprisingly, because of a fine film of factory sand which was deposited over all of the inside steel members, very little rust damage was found.

In the remodeling, the continuous monitor skylights were removed, and all wood purlins replaced with steel. Some 100 tons of steel were removed from roof and walls and reused in framing the new roof. All of the exterior frames were salvaged for new corrugated glass openings. The new roof is a poured gypsum deck over plasterboard, with 20-year bonded roof.

The old building was totally inadequate in heating and various services. Heating had been supplied from a central plant some thousand feet away. Now the building has its own boilers and a new installation of unit heaters. Ventilation was also provided, meeting code requirements. The electrical service also is new, with a 440-volt 4-wire service and distribution wiring.

Chicago Architectural Photographing Company Photo

The long-unused building was also found inadequate as to employees' facilities; accordingly, the modernization included new offices, locker rooms, toilet facilities, and so on. Also, provision was made on the second floor of office section for future installation of dining room and recreational facilities

Leonard Photo

THERE ARE OTHER REASONS besides real expansion for building new factories. They are built to house more modern, more efficient, more automatic machinery. To cut costs, to get closer to markets or material sources. To improve transportation. To improve labor conditions. To escape taxation. To simplify or unify operations..To whip competition, in one way or another. There are still ancient and seemingly revered buildings that should long since have been replaced.

All of these factors have a bearing on planning and design. Choosing the location for a new factory has become a complicated study, especially now that industry rather generally is pioneering new and undeveloped areas. The government is actively encouraging decentralization or dispersion as a safety measure in case of enemy attack. Decentralization is a natural development, in any case, as industry seeks new labor sources, new material sources, new transportation efficiencies, increased amenities for workers, freedom for future growth, and so on.

Architects and engineers are then called upon to add to their program basic items which are sometimes merely assumed — water supply, fuel, power and so on. In many instances a whole new community must somehow develop, with workers' housing, schools, shops, everything a town must have. Industry generally has seemed to dodge the responsibility, because of a dread of paternalism and its evils. In the end, however, the success of the entire project may hinge on proper community planning and development, and industrial management is not as blind in this as sometimes appears.

Which is to say that industrial expansion is a very dynamic movement, continually shifting and sharpening its requirements for buildings. It is sometimes said that industrial buildings have settled into a pattern, that they all look alike, that their designs might as well roll off some assembly line for blueprints. But it takes very little reflection to see that design can never become static. Design of buildings for industry, like industry itself, feeds upon change. Like an airplane, it must have forward movement, or fall.

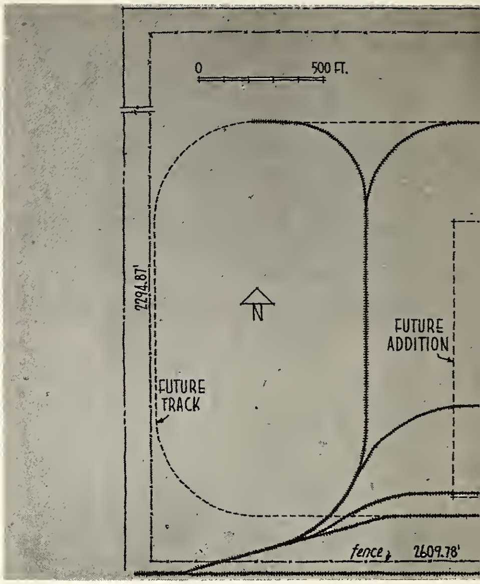
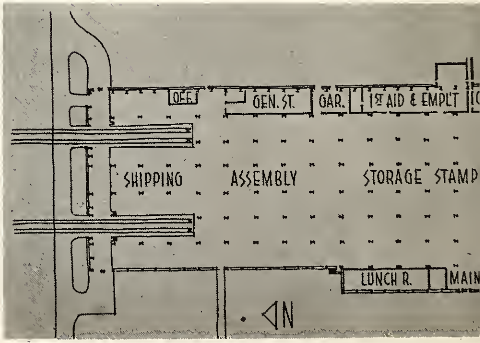
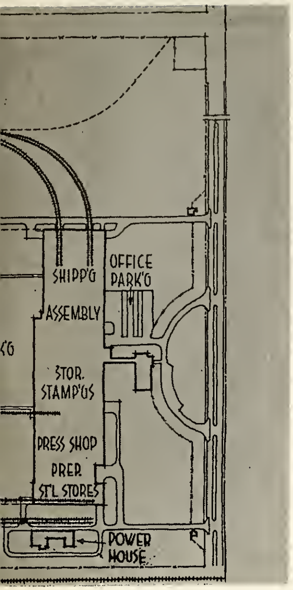


Photo: Lens Art





FLEXIBLE PLANT FOR AUTOMOBILE BODIES

The Budd Company, Chase Plant, Gary, Ind.

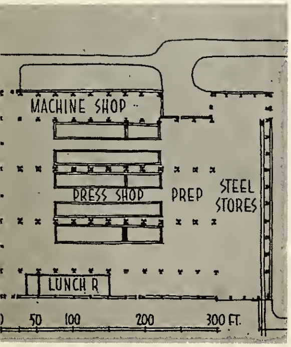
Giffels & Vallet, Inc., L. Rossetti, Architect and Engineers

THE AUTOMOBILE INDUSTRY is probably the best client industrial architects and engineers ever had. It has been a huge industry, a growing one, but perhaps more important still, an industry of constant change. In Detroit you hear of a radically improved engine which is coming in a couple of years "as soon as new plants can be built to make it." Each new development seems to require drastic changes, including new buildings, to make the new gimmick with the necessary efficiency.

This Budd plant concentrates on two parts of an automobile body—doors and roof. It was needed in a hurry when efficiency required such specialization.

One addition has already been built, increasing the assembly and shipping area by 65,000 sq ft. As the site plan shows, the plan was designed for great expansion. The first plant could be tripled in size, then a fresh start made in a second loop of railroad tracks. The power plant was placed so as not to block this growth. The original press shop, where body stampings are made, was made large enough to permit the present expansion to assembly and shipping areas.

The press room has one interesting contribution to flexibility. Normally the huge stamping machines are set in individual pits and thus are difficult to move to accommodate changes in the work line. Here the engineers worked out a long trench (there are five of them) to take the machines in any desired location (plan and sections, page 292). Prebuilt, trussed slab floor sections can be placed across the pits between machine mountings. This system makes it possible to move the huge presses back and forth at will, or even change their place in the rotation, without the delay and expense of building new pits. Actually there are three different cross sections in the five trenches; changes from one line to another would be rare, but to an extent even these could be accommodated.



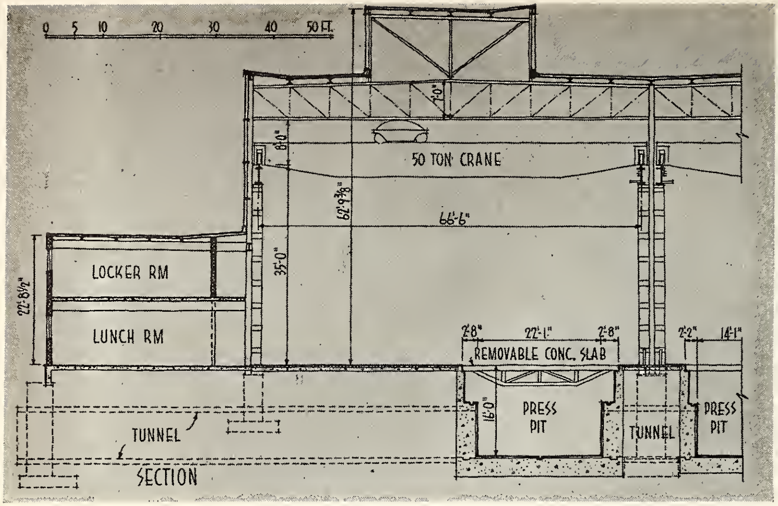
It is interesting to note that the bottom seven or eight feet in the deepest pits are below the water line in the marshy base of the sand dunes on which this building stands. Metallic waterproofing has avoided any trouble in this respect. The engineers have also been able to cope with some settling, by opening the floors at spots and pumping in sand.

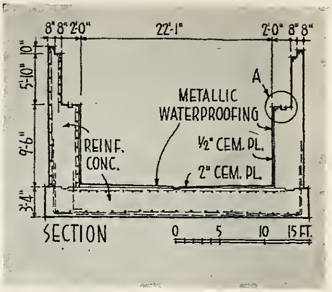
HEAVY INDUSTRY

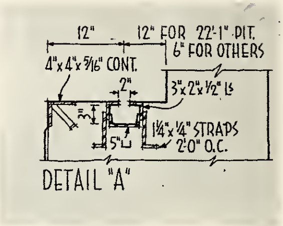
Photos: Lens Art

This shipping and assembly area has been enlarged by 65,000 sq ft since the above photograph was taken.

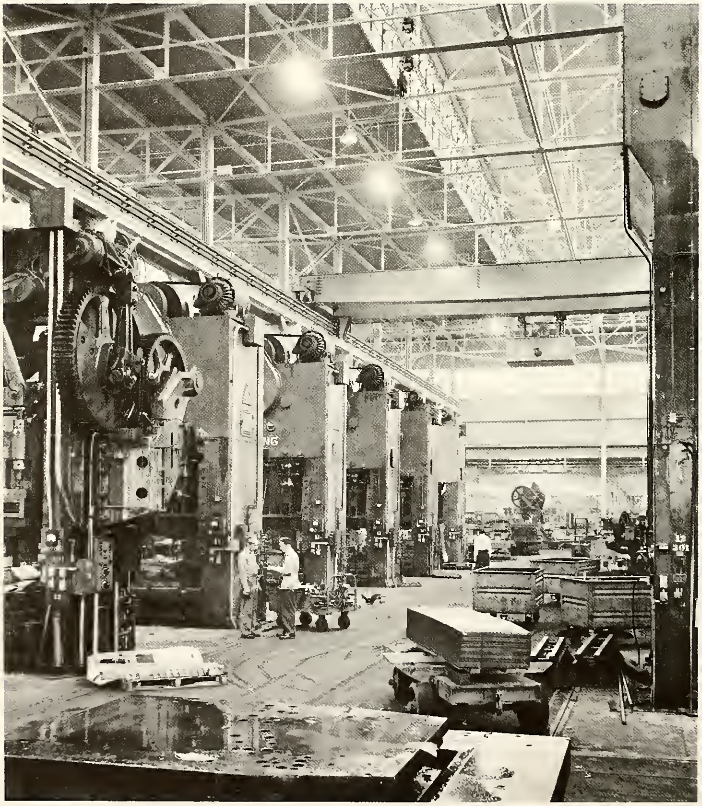
Offices are in separate buildings relatively far away from the plant, for isolation from noise of heavy metal presses





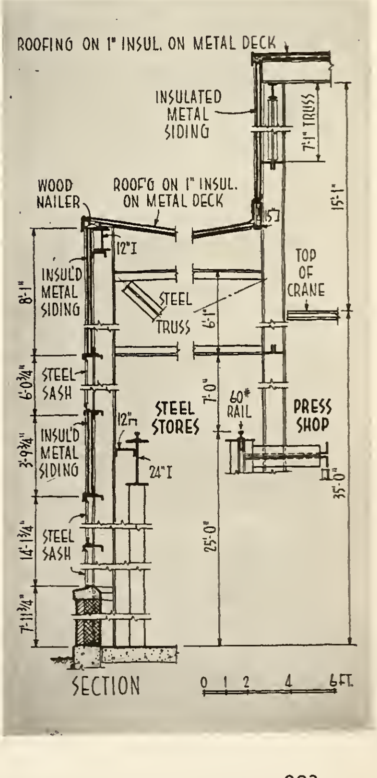


Press pit is a long trench in which the huge presses can be moved up or down the line as production changes require, are deep enough for maintenance servicing of presses. Removable trussed slab floor sections cover pits between press locations (see also small photo below)



Photograph at left shows largest metal presses in line over pits. Photo above shows underneath view of press being serviced from the trench. Note floor section in place spanning pit trench between machines

Photos: Lens Art



HUGE ASSEMBLY PLANT ENGINEERED FOR EFFICIENT, SAFE PRODUCTION

New Ford Assembly Plant
Mahwah, New Jersey

L. Rossetti
Architect
R. F. Giffels & V. E. Vallet
Engineers

This aerial view, showing houses for transformers and fans on roof, relates size of plant to that of administration building . . . which features a sunshaded façade. Design criteria and supervision of design was furnished by Plant Engineering Office of the Ford Motor Company.

Special points the designers considered:

- **Traffic**
- **Expansion Joints**
- **Drainage**
- **Fire Protection**
- **Piping**
- **Electrical Distribution**

The new Ford Assembly plant being built at Mahwah, N. J. will be a huge one — it has to be in order to turn out some 1000 units every day, and hugeness itself was responsible for some of the engineering problems neatly solved.

There were problems in traffic and materials handling, to get the workers to and from their jobs with minimum effort, and to provide smooth flow of parts from incoming delivery to the outgoing final product.

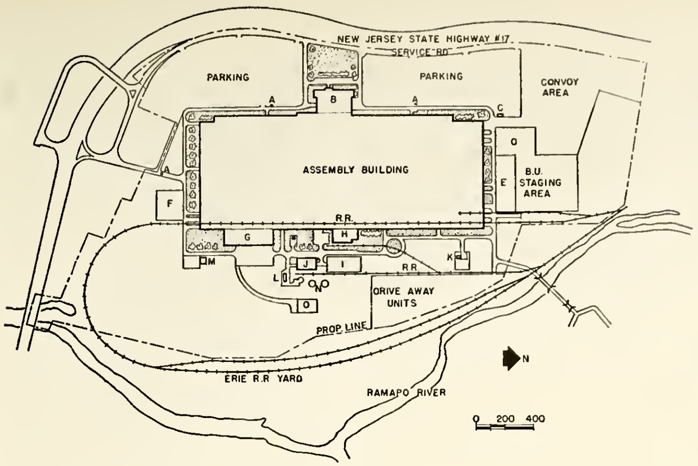
Fire protection, receiving more than ordinary attention these days, with emphasis on design, materials, and protective systems, was handled in several ways: (1) automatic sprinklers cover 100 per cent of the plant; (2) complete systems of automatic and manual alarms and independent emergency lighting are installed; (3) smoke baffles and roof vents are provided; (4) special wide fire aisles through the plant are always kept clear for fire trucks; (5) there is a complete system for hydrants, standpipes, hose reels, fire trucks and portable extinguishers (hose stations located to provide two streams at any location); (6) extra-hazard operations are physically shielded and equipped with special fire controls and alarms.

Not all of the engineering problems were confined to the assembly plant, though. The office building faces west, so it was necessary to provide some sort of protection against the sun. Trim, vertical sunshades were designed to cut out the sun and glare, while preserving the view, and also to serve as a strong element in the character of the facade.

ASSEMBLY BUILDING

Just getting workers to and from the plant was a sizable problem in traffic and parking. The accompanying site plan shows how traffic to the big parking areas will be expedited by the projected additional lanes for New Jersey Highway 17 and the overpass to the service roads now being built on the 173 ±-acre site itself.

But this is only one detail. For one to understand thoroughly all the details of planning and designing a tremendous project such as this, it would be necessary to follow the entire assembly process from the unloading and checking of thousands of parts through testing, storage, distribution, and their progress along the sub-assembly lines to the new cars rolling off the last long line.



KEY

- A. Gatehouse
- B. Administration Building
- C. New Car Checkout
- D. New Car Storage
- E. Crate Storage
- F. Passenger Frame Storage
- G. Truck Well
- H. Oil House
- I. Barrel Storage
- J. Boiler House
- K. Propane Storage
- L. Caustic Treatment
- M. Ground Maintenance Building
- N. Oil Tanks
- O. Industrial Waste Treatment

TRAFFIC HAD TO BE CAREFULLY ROUTED

Entrance to the plant by car and rail is coordinated with related activity locations within the plant. Shipping areas for new cars, both for domestic consumption and for export, are removed from other traffic

In general, parts come in by rail and truck at the east and southeast side of the plant and proceed westward to the final assembly lines at the west side of the building. The employes approach from the west side, and from either of the huge parking areas proceed to their locker rooms and then to their stations in the main assembly building.

Without attempting to go into details of the production process, it is sufficient to point out that it was the flow of parts, the lengths and speeds of the assembly lines, conveyors, and drag lines, together with their storage, handling, and testing facilities, that determined the size and shape of the plant. It was this that demanded a main building 2115 ft long and 790 ft wide.

Sectional Divisions

Because the assembly plant covers such a huge area, there are expansion joints every eight bays in both directions, one running the entire length of the building at the mid-point, and five running across the building parallel to the ends. As each bay is 45 by 50 ft, the area is divided into 12 "sections," each 360 by 400 ft, or a total of 144,000 sq ft.

Some section areas are slightly smaller, as can be seen on the roof plan, on the south and east sides of the building. In the sections facing on the south side of the plant a width of only seven bays is necessary to fulfill production requirements. On the east side of the plant, there are six 50-ft bays and one large 90-ft bay extending the length of the building over the railroad docks.

This "sectional" division has been adopted not only from a structural expansion consideration, but also because it provides a convenient economical and efficient division for the mechanical and electrical distribution systems as well, providing light, heat, ventilation, and fire protection.

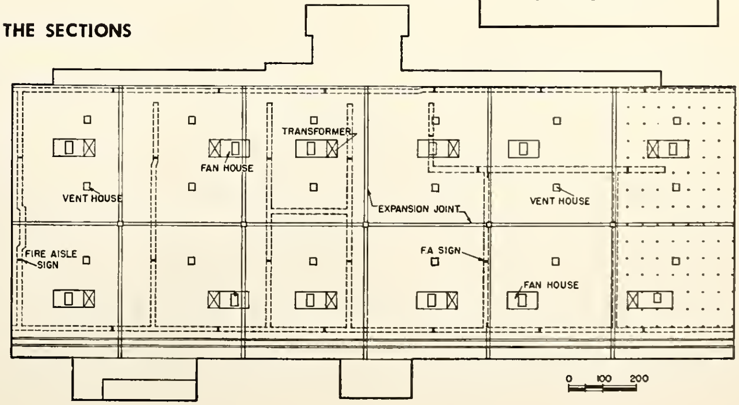
Each of the twelve sections, therefore, has its own combined fan-house and transformer substation on the roof, each some 50 by 120 ft in plan. Every sectional division also has one or two

FIRE AISLE

DO NOT BLOCK OR OBSTRUCT
UNDER
PENALTY OF THE LAW

EXPANSION JOINTS MARK THE SECTIONS

Expansion joints provided for the huge plant, as shown on this roof plan, indicate the twelve section divisions, each supplied from its own transformer substation and fan-house. The dashed lines are zoned fire aisles at floor level, which are marked at frequent intervals by signs (shown at right). Column locations are dotted in for two sections



large automatic vent-houses which, combined with strategically placed steel draft curtains, will provide smoke control and elimination in case of fire.

Structure

One of the most unusual features of the building is its imperceptible downslope from north to south. Advantage was taken of the topography of the site, and earth-moving cost was minimized by sloping the whole building ½ in. in 45 ft, or a total of 2 ft.

Structurally, the assembly building is of the usual steel columns and trusses with insulated steel deck roof. The sway frames line up with the panel points, and the web members line up to permit easy runs of pipe and duct work. The 18-ft clear height from floor to lower chord of trusses is ample, as lighting fixtures line up at the same level. The lighting and power distribution, the ventilating ducts, and the sprinklers are designed as parts of an integrated and mutually non-interfering system, all run above the bottom chords of the trusses.

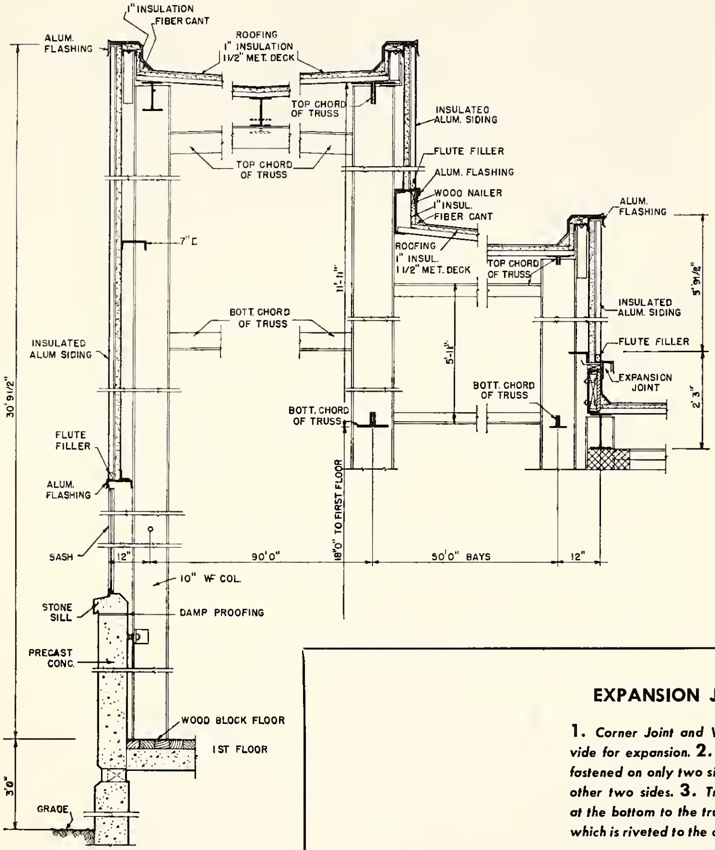
The heating and ventilating system is zoned, each penthouse supplying four zones in its "section" of the plant with filtered, blended fresh and return air. Steam coils are used for tempering. The duct system provides 10 changes of air per hour for the lower 12 ft of the building. Temperature controls are of the pneumatic type with independent compressed air sources.

General lighting of approximately 30-ft-candle intensity at 30 in. above the floor is provided by two-tube, 8-ft slim-line fixtures equally spaced 16 to each bay on messenger cables. But more of the electrical system later.

The walls, as shown in the sectional drawing, are somewhat unusual in that the masonry from floor to sill, instead of being brick or block, is a precast reinforced concrete slab some 8 ft high by 15 or 20 ft long and 8 in. thick, topped by a stone sill supporting steel sash. The wall above the sash is of insulated aluminum siding.

The 90-ft railroad shipping and receiving bay along the east side of the plant has a clear height of 21 ft 3 in. to the bottom of the trusses.

These trusses carry two 90-ft, underslung, 5-ton cranes. At the north end of the plant, a 5-ton crane of 100 ft span,

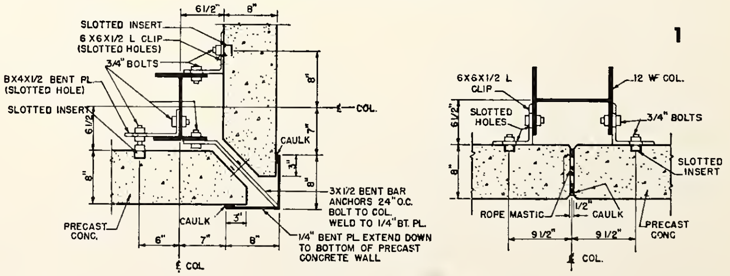


NORTH-SOUTH WALL SECTION *showing supporting precast reinforced concrete panel, indicates relative roof heights for 90-ft railroad bay, general assembly area, administration building*

EXPANSION JOINTS

1. Corner Joint and Wall Joint. Slotted bolt holes provide for expansion. 2. Roof Expansion joint. Plate hood, fastened on only two sides, allows 3 in. expansion on the other two sides. 3. Truss Connection. Steel bar pinned at the bottom to the truss and at the top to a steel plate, which is riveted to the column, allows the truss free swing

1



21 ft 3 in. clear height, is used to handle export shipping.

The high railroad bays run the entire length of the east side of the building. Since they are higher than the adjacent roof, smoke-venting is permitted through six hinged doors each 90 ft long, one for each 360-ft section. The double track is the standard 3 ft 6 in. below the wood-block floor of the dock.

Incidentally, five cross-over bridges of the hydraulic lift type, each 15 ft wide, can be raised from the double-track level at convenient intervals permitting access to both sides of the dock. Positive safety controls are installed for the use of these bridges and for the vertical folding doors which are operated for entering or leaving freight cars. The system provides both individual and master controls with warning bells and warning lights at each bridge as well as derail interlocks designed to guard against possible accidents.

Adjacent to the railroad dock, near the southeast corner, is the truck-well and quality-control wing extending some 120 by 360 ft. The truck-well is 270 ft long, equipped with 10-ton-capacity hydraulic leveling lifts to expedite deliveries.

Floor slabs on the ground are, in general, of 3000-psi concrete, 6 in. thick, reinforced with ⅜-in. round bars, 12 in. on center both ways in the top. Storage-area slabs are 8 in. thick reinforced with ½-in. bars, 12 in. on centers both ways in the bottom and 24 in. in the top. Assembly-area floors are monolithic concrete with wear-resistant hardener, except the rail and truck docks, which are of 2½-in. wood blocks. There are other exceptions, such as acid-resisting vinyl plastic tile in the chemical laboratory, asphalt tile in offices, etc.

Fire Protection

Many devices and methods of preventing, detecting and fighting fires are being incorporated in the plant. In addition to the draft-curtain and vent provisions, the entire plant is thoroughly provided with the newest type wide-coverage automatic sprinklers.

There are sprinkler alarms for each sprinkler riser or group of risers and fire horns throughout the assembly areas. Manual fire alarms are located at strategic points, and there are two-way hydrants every 300 ft and an underground fire loop 12 in. in diameter. One-hundred-foot, 1½-in. hose reels in cabinets in the office section provide protection there.

The oil house and paint-mix room have extra-hazardous-occupancy sprinklers, and the paint-mix room is provided, in addition, with a two-shot carbon dioxide system, the first automatic, the second manual. There is the added protection of a Class A wall between the oil house and the main building, extending 20 ft on either side. There are remote-control emergency stop-buttons for the gasoline distributing system. Spark-proof floors are used where there might be any danger from scuff-sparks.

The 10-day propane standby system is protected by sufficient hydrants for four 2½-in. hose streams. The fire alarm system is of the electric, manual, coded, positive, non-interfering and successive type, with the main unit in the plant protection office, and there are fire gongs and lights as well as horns.

A practical system of wide fire aisles, well marked and always kept clear, makes possible the immediate accessibility of major mobile fire-fighting equipment and personnel (both professional and trained volunteer) throughout the plant.

Then, too, the emergency lighting system is of the automatic charging and operating storage battery type, each unit self-contained and independent, insuring adequate lighting at all times for egress.

Electrical Distribution and Communications

A few notes indicating size and function of the electrical systems may be in order. Electric current is supplied by the public utility, and the plant transformer capacity is 24,000 kva. Primary power of 13.2 kv is distributed through underground cable ducts in concrete to the transformer stations on the roof via rigid conduit encased in concrete adjacent to the columns.

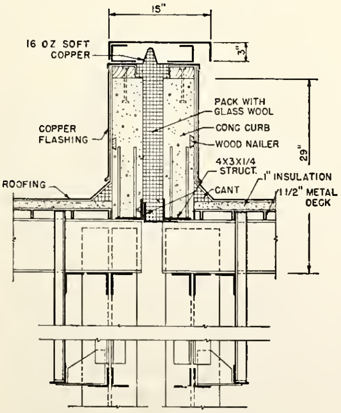
Three-phase, 60-cycle secondary power is supplied from the transformers at 480 volts. The assembly plant is served from 400-amp plug-in bus ducts on 100-ft centers above the lower chords of the trusses. Plug receptacles, 440-volt, 60-amp, are installed in the webs of columns.

The underfloor duct system in office areas consists of three separate steel ducts, one for 120/208-volt service, one for telephone and one for intercommunications. Equipment for 400 telephones will be provided at first, with space allowed for 600 eventually. In addition to the lighting and fire alarm systems, mentioned elsewhere, there are a Telautograph system, an electric time-clock system, a watchman's report system, and a dismissal signal system.

Process Piping, Sanitation, Drainage

Because Bonderizing and body painting are major operations, an elaborate system of chemical and water supply and subsequent industrial and paint waste disposal had to be worked out. This involved, among many things, a 30,000-gal treatment tank, a 12,000-gal ferric chloride tank (rubber-lined), a 12,000-gal calcium chloride tank, and one for 1000 gal of sulfuric acid. A

2



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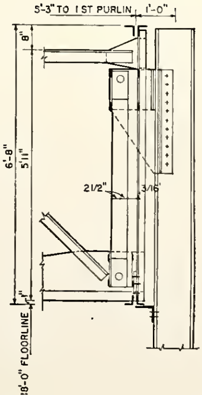
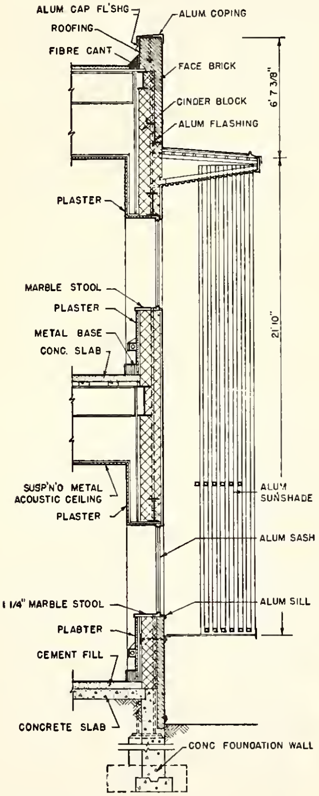


sludge lagoon of 300,000 gal capacity is required for settling.

Some of the mechanical engineers' problems are indicated by the fact that natural gas at 100,000 cu ft per hr is consumed, and both oxygen and acetylene are to be supplied for welding operations. There are 12 underground tanks, each of 20,000 gal capacity, in the oil tank farm

The sanitary system serves the locker rooms and toilets, kitchens, etc. In the assembly plant proper the toilet rooms are in mezzanines that leave a clear height of 12 ft above the main floor.

The storm sewer system takes care of the roof drainage and the run-off from the parking areas.



VERTICAL SUNSHADE

Filters out heat and glare of sun and yet, through use of tubular aluminum baffles, permits free flow of air

The slight roof slope, together with specially designed, restricted orifice roof sumps, decreases the rate of run-off from the roof and thus controls the flow and reduces the size of the storm sewer lines. The consequent slowing of the run-off (which is taken care of in the 40-lb live load of the roof) makes it possible to limit the number of roof sumps and down-spouts to an average two per roof section of 144,000 sq ft. The down-spouts are brought down at unobstructing points to storm sewers emptying into the Ramapo River. Incidentally, however, the parking lot run-off will be rapid, as the lots will have a 2 per cent slope.

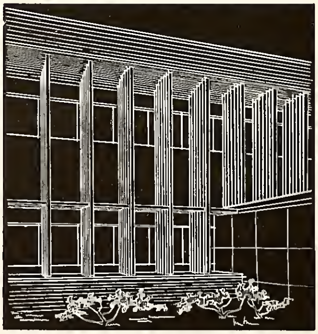
Additions to Assembly Plant

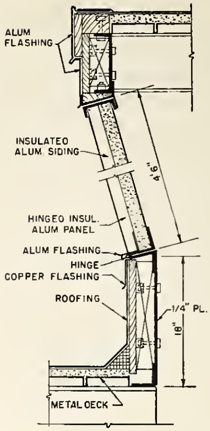
While this plant may seem to be large enough for both the present and some years to come, the possibility of future additions has been taken into account in the planning, and bays can be added at both north and south ends of the building. Flexibility of area use and of services is provided to take care of changes in assembly processes and techniques.

OFFICE BUILDING

The most striking feature to be seen from Highway 17 is the facade of the two-story office building. Because this building faces west, the sunshade has been designed to eliminate the glare and heat of the sun from the windows of the western facade. The detail drawing shows the construction of the aluminum sun baffles.

The office building (300 by 55 ft) has non-combustible acoustical ceilings, movable metal partitions, asphalt tile floors, and louvred lighting fixtures. Perimeter heating is provided by forced-hot-water guarded finned tubes, the temperature of the water being controlled by the temperature of the interior surface of exposed glass.





VENT-HOUSES LET OUT SMOKE IN CASE OF FIRE

Vents swing down from top when fusible link melts at a temperature slightly lower than the critical temperature (165 F) of the sprinkler heads. Vents can also be operated manually from the floor

Fire Protection Devices in Assembly Plant

	Total No.	Distance on Centers
Sprinkler Heads	18,114	*
2-Way Hydrants	26	300 ft
Manual Fire Alarms	50	200 ft
Roof Vent-Houses	18	200 ft†
High RR Bay Vents	6	360 ft

** Each sprinkler head covers an area of 120 sq. ft.*
† In the north-south direction vent-houses and draft curtains are alternately spaced every 180 ft.

This office, or administration, building is connected to the main plant by the wing in which are the private dining rooms, the large main kitchen, and the garage. The main kitchen serves the three cafeterias in the employes facilities building, one centrally located adjacent to the kitchen and the others north and south to serve those areas. Each of the latter has its own serving kitchen to assure hot food and beverages.

The employes facilities building, through which employes pass, runs 1780 ft along the west side of the plant. In addition to the cafeterias, it provides locker-rooms, toilets, hospital, employment and personnel departments, etc.

Joseph W. Molitor

HIGHLY FUNCTIONAL PLANT FOR HELICOPTERS

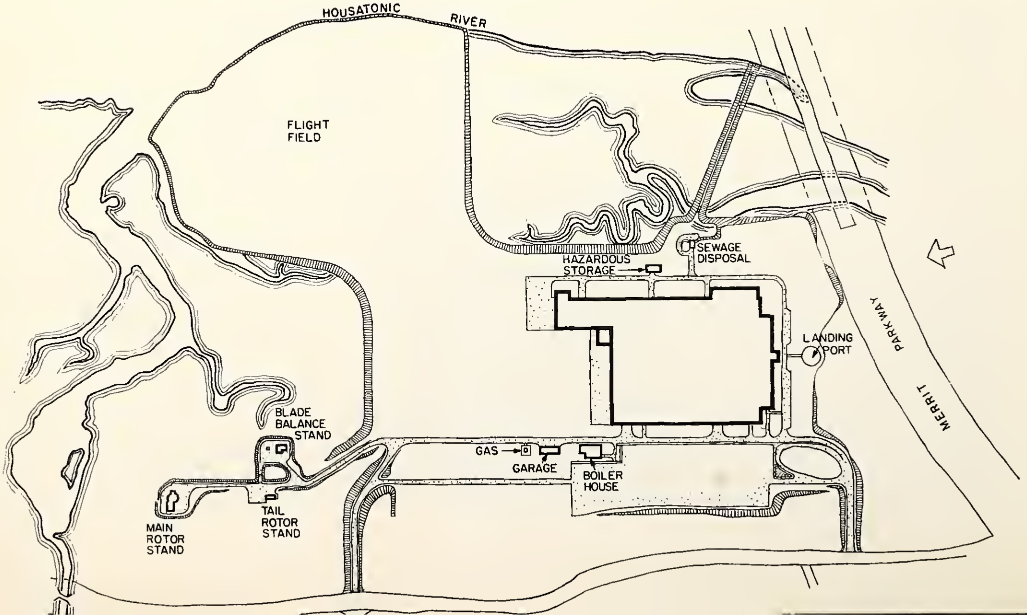
Manufacturing Plant for Sikorsky Aircraft Division, United Aircraft Corporation
Stratford, Connecticut

F. A. Fairbrother and Geo. H. Miehls, Architect and Engineer
Albert Kahn Associated Architects and Engineers, Consultants

Rarely does functional building design involve so many different complications as the architects and engineers encountered in this manufacturing plant for helicopters. Though the plant is large (800,000 sq ft of floor space), mere size was less of a factor than the complications of helicopter manufacture. One section, for example, has a height of 36 ft and a clear span of 180 ft. Site preparation involved the moving of 1,450,000 cu yd of material. Then there were some highly special requirements for air conditioning and ventilation, for fire protection, and other special needs.

Comprehensive survey of many other areas throughout Connecticut and adjacent states preceded selection of the Stratford site as most closely meeting the requirements for the type of installations contemplated. Terrain of the acreage selected included farm land, sandy gravel knolls and hills, rocky and swampy back water areas. Final grades were set to provide a maximum of fill material to level and fill the greatest possible percentage of the site. Sizeable hillocks were cut down to provide fill in the swampy meadows adjacent to the Housatonic River and to bring the ground to the eleva-

Joseph W. Molitor



tions desired for the buildings, parking lot, roadways, possible future extensions to the North and East, flight field, and access roads to various test stands.

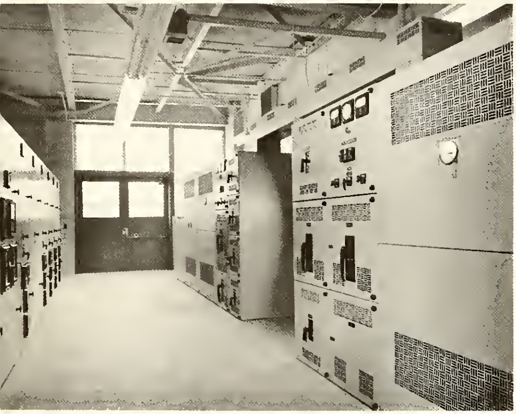
The main manufacturing building is 820 ft long by 700 ft wide, with an extension to the north of 180 ft by 300 ft which houses the hangar area. An attached office building along the south end of the plant is two stories high and has a basement area 60 ft wide by 520 ft long. At the northeast corner of the hangar is a two-story projection 80 ft long by 40 ft wide which is known as the pilots' ready area.

Construction consists, generally, of steel columns and trusses. Column spacing in the low bay area forms bays 40 ft by 60 ft and 40 ft by 70 ft with 16-ft clearance to the bottom chords of the trusses. The hangar and final assembly area, extending along the east side of the building, has a clear height of 36 ft under main roof carrying trusses and a clear span of 180 ft in width. Orville Wright could have made his epic first flight in the 180 ft clear span of this high bay — going across the bay, not down its length.

Exterior walls are of face brick backed up with concrete block to a sill height of 8 ft, aluminum projected sash, and insulated fluted aluminum siding. The roof, some 18 acres in area, is constructed of poured gypsum and composition roofing.

Toilet facilities are conveniently spaced throughout the first floor of the manufacturing area with foremen's offices located above. Locker rooms, plant protection headquarters, and employment facilities are located in the basement area near the manufacturing employees' entrance. The basement area and all the rooms off it are of extra heavy blast resistant construction. In all, it is an area about 120 ft by 200 ft overlaid with 12 in of reinforced concrete. One end of the administration building (about 60 ft by 180 ft) has received similar treatment. In an emergency the two areas could shelter approximately 5000 people.

The two-story area and the blade room in the factory section are completely air conditioned. The blade room



Joseph W. Molitor

requirements are definitely fixed as to temperature and humidity throughout the entire year. In general, the air conditioning equipment for both the office area and the blade room are identical, the variations being in the control limits. The system consists of air filters, water cooling coils through which outdoor or recirculated air is drawn by a motor driven fan unit, and the fan unit which discharges the air through zone coils and ducts to various parts of the rooms. The requirements of the distribution system made it essential to provide different air temperatures around the outer zones near the exterior walls than are required for the interior areas where the heat gains and heat losses throughout the year are nearly constant.

Although the blade room is one completely enclosed area, separate zones are provided sectionalizing this room to permit different degrees of temperatures on the supply air system to balance the heat release given off by various pieces of equipment, thus making it possible to obtain the same room temperature throughout irrespective of the heat liberated by certain pieces of equipment.

The fire protection consists, generally, of complete wet pipe automatic sprinkler protection throughout the manufacturing building, with the exception of the transformer rooms, fan rooms and light hazard administration facilities.

Special hazard protection, consisting of automatic deluge systems of open type "water spray" sprinklers, are provided for the extinguishment of hazardous fires and the dispersion of flammable vapors or liquids within the aircraft hangar and the final assembly paint spray booths. Certain hazardous areas are protected by a complete wet pipe automatic sprinkler system, others are served by a "two-shot" high pressure, automatic carbon dioxide fire extinguishing system.

The exterior protection consists of underground fire mains enclosing the manufacturing building, with fire hydrants and roof standpipes provided at strategic locations.

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